Construction Details on
Single sideband Amateur Transmitter

SSB- 1

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COLLINS

COLLINS RADIO COMPANY

CEDAR RAPIDS, IOWA

No. 94962

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Order No. Or Clock No.

Date 8/27/57

Street

City

State

SOLD BY	CASH	C.O.D.	CHARGE	VIA	FACILITY	STOCK	PAY DEDUCTION	INSTAL.	INVENTORY CODE
60156	✓			self		✓			1238

Quantity	Part Number	U/M	DESCRIPTION	Price	Amount
2	004-1331		6" Rule Steel	35	70
1	004-1870		EZ Hold Screw Driver		50
					1 20
					02
					1 22

Paid

F.O.B. Cash

TAX 02

Received By C B Cloonan

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TOTAL 1 24

EO

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C. McMahon
8-27-57

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COLLINS RADIO COMPANY

CEDAR RAPIDS, IOWA

No. 88490

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Street Engr Bldg. Ext 354 City

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State

SOLD BY	CASH	C.O.D.	CHARGE	VIA	FACILITY	STOCK	PAY DEDUCTION	INSTAL.	INVENTORY CODE
4501	✓			Self					1243

Quantity	Part Number	U/M	DESCRIPTION	Price	Amount
1	541-6291-00	7	Kit		
					8 43
			10%		84
			OK per Merril Lund.		

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TAX	19
TOTAL	9 46

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GRID TUNING

FREQ.	SETTING
3.5	46
3.6	41
3.7	36
3.8	31
3.9	26
4.0	21
4.1	16
4.2	12
4.3	8
4.4	4
4.5	0

KEN-ELS RADIO SUPPLY CO.

MERCHANDISE FOR RESALE

501 - 1st Ave. No.
Fort Dodge, Iowa
Phone 3-8801

67 - 16th Ave., S. W.
Cedar Rapids, Iowa
Phone 4-1172

Customer's Order No. W0TWD Date 3-16 1957

Name C. B. Cloonan

Address

SOLD BY	CASH	C. O. D.	CHARGE	ON ACCT.	MDSE. RETD.	PAID OUT
VM	✓					

QUAN.	DESCRIPTION	PRICE	AMOUNT
1	B+W 3003		36
1	B+W 3006		45
2	6C 1742	06	12
			93
	tax		02
			95

Thank You

All claims and returned goods MUST be accompanied by this bill.

No. 48238

Rec'd by

Kepler Printing Co., Fort Dodge, Ia.

IOWA RADIO SUPPLY CO.

Wholesale Only

Phone 4-6154 **719 Center Point Road N. E.** **Cedar Rapids, Ia.**

Your best buy Iowa Radio Supply

No. 58146 CUST. ORDER NO. DATE 1-31- 1957

SOLD TO cash

ADDRESS

SALE				MDSE. RET'D				REC'D ON ACCOUNT-NOTE		PAID OUT	
CASH		CHARGE		CASH		CREDIT					
	X										

QUANT.	PART NO.	ARTICLES	PRICE	AMOUNT	
7	4405	Clips 11			22
			tax		01
					23
		TAX			
		TOTAL			

1

SALESMAN

REC'D BY

FORM PART 8 12-51 PRINTED BY THE STANDARD REGISTER CO., DAYTON 1, OHIO, U.S.A.

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COLLINS RADIO COMPANY

CEDAR RAPIDS, IOWA

No. 88101

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~~Order No. Or~~ Clock No. 61852

Date 5/29/57

Street Engr Bldg Ext 354-413

City

State

SOLD BY	CASH	C.O.D.	CHARGE	VIA	FACILITY	STOCK	PAY DEDUCTION	INSTAL.	INVENTORY CODE
4501				Self.			✓	1	1227

Quantity	Part Number	U/M	DESCRIPTION	Price	Amount
1	376-4205-00	7	Pot		16
1	376-4499-00	7	[illegible]		16
1	376-5701-00	7	Pot		28
26	503-0644-001	7	washer	0390	1 01
x1	504-7009-001	7	7.61		74
			$1.76 10%		

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TAX		06
TOTAL		2 65

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No. 88100

COLLINS RADIO COMPANY

CEDAR RAPIDS, IOWA

Sold To C B Cloonan

~~Order No. Or~~ Clock No. 61852

Date 5/29/57

Street Engr Bldg Dept 354-413 City

State

SOLD BY	CASH	C.O.D.	CHARGE	VIA	FACILITY	STOCK	PAY DEDUCTION	INSTAL.	INVENTORY CODE
4501				Jeff			✓	1	1227

Quantity	Part Number	U/M	DESCRIPTION	Price		Amount	
							77
1	504-7035-002	7					62
1	505-0361-002	7				1	17
1	505-6723-001	7				1	17
1	505-6724-001	7					32
1	540-5176-002	7					41
			10%				
				TAX			11
				TOTAL		4	57

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CEDAR RAPIDS, IOWA

No. 88108

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Date 5/29/59

Street

City

State

SOLD BY	CASH	C.O.D.	CHARGE	VIA	FACILITY	STOCK	PAY DEDUCTION	INSTAL.	INVENTORY CODE
4501	✓			Self					1211

Quantity	Part Number	U/M	DESCRIPTION	Price	Amount
3.6	8041-07-3696	01		5170	1 86
			10%		19
				TAX	05
				TOTAL	2 10

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432
457
265
11.54

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No. 88099

COLLINS RADIO COMPANY

CEDAR RAPIDS, IOWA

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Date 5/29/57

Street Eng. Bldg Ext 354-413 City

State

SOLD BY	CASH	C.O.D.	CHARGE	VIA	FACILITY	STOCK	PAY DEDUCTION	INSTAL.	INVENTORY CODE
4501				Ref.			✓	1	1227

Quantity	Part Number	U/M	DESCRIPTION	Price	Amount
1	291-8133-00	7			2 95
1	340-2090-00	7			04
1	504-7010-001	7			05
1	504-7022-001	7			48
1	504-7032-002	7			25
1	504-7033-002	7			26
					38
			10%	TAX	11
F.O.B.			Packed By	TOTAL	4 32

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COLLINS RADIO COMPANY

CEDAR RAPIDS, IOWA

No. 88388

Sold To Cliff Cloonan

Order No. Or Clock No.

Date 7/23/57

Street Engr Bldg Ext 357

City

State

SOLD BY	CASH	C.O.D.	CHARGE	VIA	FACILITY	STOCK	PAY DEDUCTION	INSTAL.	INVENTORY CODE
4501	✓			[illegible]					1227

Quantity	Part Number	U/M	DESCRIPTION	Price		Amount	
1	290-0017-009	7				1	73
1	290-0374-009	7				1	85
			10%				36

F.O.B.		TAX	08
Received By	Packed By	TOTAL	4 02

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COLLINS RADIO COMPANY

CEDAR RAPIDS, IOWA

No. 88225

COLLINS

Sold To Clif. Cloonan

Order No. Or Clock No.

Date 6/24/57

Street Engr Bldg Ext 354-418

City

State

SOLD BY	CASH	C.O.D.	CHARGE	VIA	FACILITY	STOCK	PAY DEDUCTION	INSTAL.	INVENTORY CODE
4501	✓			Self					1227

Quantity	Part Number	U/M	DESCRIPTION	Price	Amount
1	504-7006-001	07			20
			10%		02
			[illegible]		
			[illegible]		

F.O.B.		TAX	01
Received By	Packed By	TOTAL	23

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COLLINS RADIO COMPANY

CEDAR RAPIDS, IOWA

COLLINS

No. 81563

Sold To Cash Sale

Order No. Or Clock No.

Date 3 2 57

Street

City

State

SOLD BY	CASH	C.O.D.	CHARGE	VIA	FACILITY	STOCK	PAY DEDUCTION	INSTAL.	INVENTORY CODE
11671	✓			self					1591

Quantity	Part Number	U/M	DESCRIPTION	Price		Amount	
2			4X150-A tube		50	1	00
1			Set of schematics				60

F.O.B.		TAX		04
Received By	Packed By	TOTAL	1	64

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PACKING SLIP

REGISTER SALES SLIP

COLLINS RADIO COMPANY

CEDAR RAPIDS, IOWA

No. 88190

COLLINS

Sold To E. Elooman

Order No. Or Clock No.

Date 4/8/57

Street Eng. Bldg Dept 354 City

State

SOLD BY	CASH	C.O.D.	CHARGE	VIA	FACILITY	STOCK	PAY DEDUCTION	INSTAL.	INVENTORY CODE
4504	✓			Self					1227

Quantity	Part Number	U/M	DESCRIPTION
1	596-2924-002	7	Mech Filter
			10%

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No. 84659

COLLINS RADIO COMPANY

CEDAR RAPIDS, IOWA

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Street

City

Order No. Or Clock No. 61852

State

Date 12-28-56

SOLD BY	CASH	C.O.D.	CHARGE	VIA	FACILITY	STOCK	PAY DEDUCTION	INSTAL.	INVENTORY CODE
H93			✓	self		✓			1278

Quantity	Part Number	U/M	DESCRIPTION	Price	Amount
5	006-1242		#100 Wire Strippers	.50	2 50
1	004-1331		6" Scale		35
1	006-1118		#777 Crestoloy		1 95
1	004-1247		#41-4" Diagonal		1 60
1	004-1327		Pocket Scriber		75
					7 15
			Deduct from Check Handling		18
				TAX	7 33
				TOTAL	18
					7.51

F.O.B.

Received By Clifford B. Cloonan

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REGISTER SALES SLIP

No. 81135

COLLINS RADIO COMPANY

CEDAR RAPIDS, IOWA

Sold To Cash Sales

Order No. Or Clock No.

Date 11-24-56

Street

City

State

SOLD BY	CASH	C.O.D.	CHARGE	VIA	FACILITY	STOCK	PAY DEDUCTION	INSTAL.	INVENTORY CODE
1157	✓			Self					1591

Quantity	Part Number	U/M	DESCRIPTION	Price	Amount
1			transformer		6 00
1			Choke		2 50
1			Set of [illegible]		2 05
					10 55
				TAX	26
				TOTAL	10 81

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3.500
3.750

3.750
4.000

MIXING SCHEME
VFO FREQ = 3.500 — I.F. INJ. FREQ.

BANDS	XTAL OSC
3.5 – 4.5	
6.5 — 7.5	3.000 Mc
13.5 — 14.5	10.000 Mc
20.5 — 21.5	17.000 Mc
28.0 — 29.0	24.500 Mc
29.0 — 30.0	25.500 Mc

25.000 ⇒ 28.5–29.5

200 FT

NOMINAL 32

#1 DPDT ANTENNA
PULL IN – 28 VOLTS

D.C. RESISTANCE = 250 Ω
DROP OUT – 8 VOLTS

VOLT-AMPS = $32 \cdot \frac{32}{250} = 4.1$

NOMINAL 24

#2 D.P.D.T.
PULL IN – 18 VOLTS

D.C. RESISTANCE = 210 Ω
DROP OUT – 4 VOLTS

VOLT-AMPS = $24 \cdot \frac{24}{210} = 2.75$

FOR 6 VOLT OPERATION

#1 REQUIRES $\frac{4.1}{6} = .68$ amp ∴ Ω RESISTANCE OF COIL = 8.8 Ω

#2 REQUIRES $\frac{2.75}{6} = .46$ amp ∴ Ω RESISTANCE OF COIL = 13 Ω

$8 \overline{)103}$

#2 3/4" Winding Space

OUTSIDE DIAM = 11/16

$6 \overline{)200}$ 33
18
20

#30 WIRE × 25' 16 layers

KWS-1 RELAY
VA = 4.6

2850 Ω
115 VOLTS .04 amp VA = 4.6

@ 6 VOLTS $\frac{4.6}{6} = .8$ amp

$R = \frac{E}{I} = \frac{6}{.8} = 7.5\ \Omega$

meter resistance = 18.5 Ω   FS = 2Ma

100 Ma FS $R_S = \frac{Rm(2)}{98} = \frac{37}{98} = .38\,\Omega$

[illegible] $R_S = \frac{2Rm}{4} = \frac{37}{4} = 2.25\,\Omega$

50Ma FS $R_S = \frac{2Rm}{48} = \frac{37}{48} = .77\,\Omega$

check

$R_S = \frac{Rm}{n-1}$

for n = 50 $R_S = \frac{18.5}{49} = .38$

12 μhy choke R = .86 Ω

3.9 μhy choke R = 1.21 Ω   61852

10.0 μhy choke   R = .55

6.8 μhy choke   R = .33

R = .44

$10.5 = \frac{18.5}{n-1}$

$n = \frac{18.5}{10} + 1 = 1.85 + 1 =$

$\begin{array}{r} 1\ 1 \\ 2.85 \\ 2 \\ \hline 5.70 \end{array}$

300

300
.030
9,000

300 volts
.050
1,500

COIL TABLE

L_1

80	33 μhy	C = ~~60~~ μμf	Q = 50
40	10 μhy	C =	
20	3.3 μhy	C = ~~45~~ 34	Q = 83
15	1.5 μhy	C = 33	Q = 90
10			

L_2

80	27 μhy	C = 60	Q = 50
40	8.2 μhy	C = 60 μμf	Q = 70
20	2.7 μhy	C = 45	Q = 83
15	1.5 μhy	C = 33	
10			

$$B_n = B_1 \sqrt{2^{\frac{1}{2}} - 1}$$

$$\sqrt{.41}$$

mitter, insert a plug-in coil which will provide the instrument with the desired tuning range. The operate switch should be in the "off" position. Turn on the transmitter and *loosely* couple the wavemeter to the desired tank circuit. Tune the wavemeter for maximum meter reading. The tuning dial will indicate the output frequency of this stage.

Measurement of Capacitance or Inductance Values—The value of a capacitor in the range of 10 to 1000 $\mu\mu$f can be measured as follows: Connect the unknown capacitor across a 1.3 μh standard coil as shown in Figure 1. Starting with the lowest-frequency-range coil plugged into the instrument, determine the resonant frequency of the standard coil and the unknown capacitor. When the resonant frequency is found, utilize the chart shown in Figure 2 to determine the value of the unknown capacitor. A capacitor of 100 $\mu\mu$f, for example, will resonate with the test coil at a frequency of 12.2 Mc.

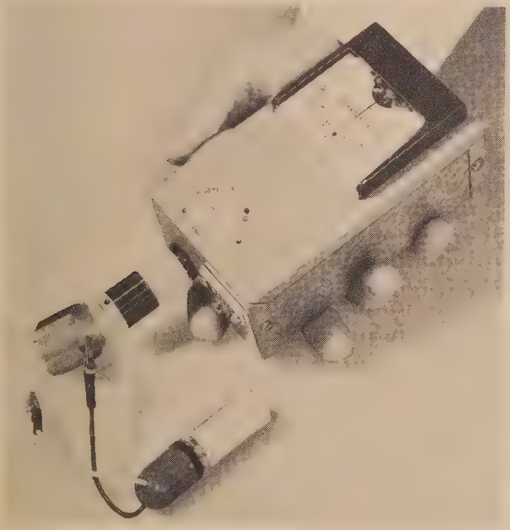


Figure 3: Use of grid-dip meter to measure an unknown inductance. A standard capacitor of 18 $\mu\mu$f is utilized. This standard capacitor is mounted inside an Amphenol type 24-5H coil form.

The value of an inductance in the range 1 to 100 μh can be accomplished in a similar manner, except a standard capacitor of 18 $\mu\mu$f is utilized. Connect the standard capacitor across the unknown inductance, as shown in Figure 3, and determine the resonant frequency of this circuit. Utilizing the chart, determine the value of the unknown inductance. An inductance of 5 μh, for example, will resonate with the standard capacitor at a frequency of 17.5 Mc.

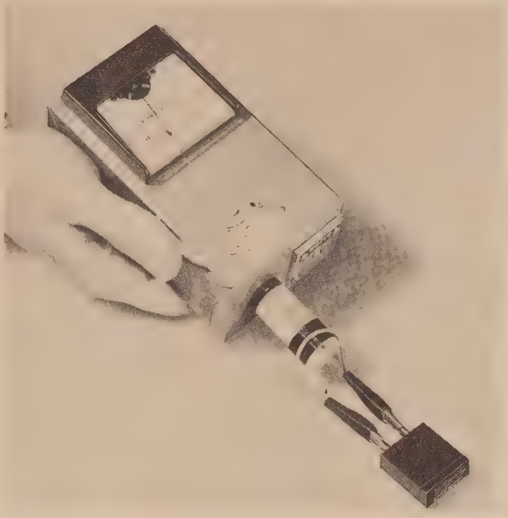
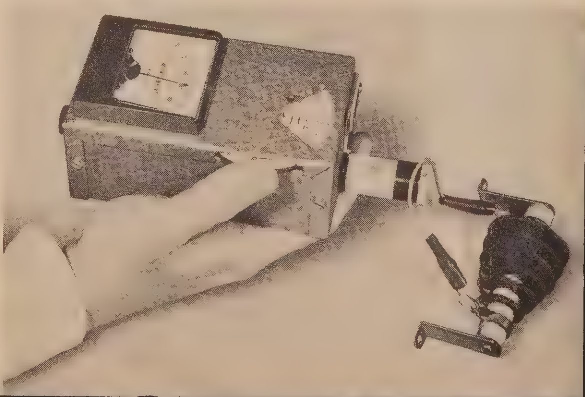


Figure 4: Use of grid-dip meter to test a quartz crystal.

Testing Quartz Crystals—The frequency of a quartz crystal may be determined by connecting a short length of wire to each of the crystal holder pins to form a small loop (see Figure 4). Couple the grid-dip meter coil tightly by inserting the coil inside the loop of wire. Tune the instrument slowly until a dip occurs, then loosen the coupling and re-"dip" the circuit. Read the crystal frequency on the tuning dial. This test also indicates activity of the crystal. The meter will not dip with an inactive crystal.

Checking RF Chokes for Self-Resonance—It is important that rf chokes used in parallel or shunt fed circuits be free of series resonance over the operating frequency range of the circuit to prevent their burning out. The popular pi-tank circuit is such an example in which the rf choke is shunted across the full rf output of the tube. To test the choke for series resonance, short-circuit the choke and determine its resonance frequencies with the grid-dip meter, as shown in Figure 5.

Figure 5: Use of grid-dip meter to test series resonant frequency of an rf choke.



From your local RCA distributor, headquarters for RCA receiving and power tubes.

RCA HAM TIPS is published by the RCA Electron Tube Division, Harrison, N. J. It is available free of charge from RCA distributors.

•

Harvey Slovik, Editor
Robert Leedy, W2PMP
Technical Editor

RADIO CORPORATION OF AMERICA
ELECTRON TUBE DIVISION
415 SOUTH FIFTH STREET
HARRISON, NEW JERSEY

WHEN MAILING
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[illegible] INC.
161 W. San Fernando, [illegible] Box [illegible]
San Jose, California

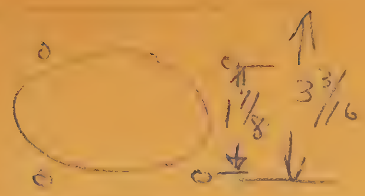
FORM 3547 REQUESTED

Devices and arrangements shown or described herein may use patents of RCA or others. Information contained herein is furnished without responsibility by RCA for its use and without prejudice to RCA's patent rights.

Longer Life for Your RCA-6146 Beam Power Tube

Due to the extreme popularity of the RCA-6146 beam power tube among hams, HAM TIPS again presents a few do's which should help you to considerably increase the already long life of this type.

- Hold heater voltage at 6.3 volts—at tube terminals.
- Provide for adequate ventilation around tube to prevent tube and circuit damage caused by overheating.
- Keep shiny shielding surfaces away from tube to prevent heat reflection back into tube.
- Design circuits around tube to use lowest possible value of resistance in grid circuit and screen circuit.
- In high frequency service, operate tube under load conditions such that maximum rated plate current flows at the plate voltage which will give maximum rated input.
- Have overload protection in plate and screen circuits to protect tube in the event of driver failure.
- See that plate shows no color when operated at full ratings (CCS or ICAS conditions).
- Reduce B+ or insert additional screen resistance when tuning under no-load conditions to prevent exceeding grid-No. 2 input rating.
- Maintain tuning and loading adjustments precisely so that tube will not be subjected to excessive overload. The 6146 is a high-gain, high-perveance tube and can be more easily overloaded through circuit misadjustments than older types not having such features.
- Use adequate grid drive, keeping within maximum grid-current and screen dissipation ratings of tube. Too little grid drive can cause high plate dissipation.
- Make connections to plate with flexible lead to prevent strain on cap seal.
- Operate 6146 within RCA ratings as shown in technical bulletin available on request from RCA Commercial Engineering, Harrison, N. J.



[illegible] 3 [illegible]   91

ALC LINE   9

PTT FM [illegible]   96

[illegible] TO MIKE   923

[illegible] CAL [illegible]   905

TO [illegible] FM [illegible]   903

TO [illegible] FM 28V LINE   93

-150 V   6

OSC FIL GND   9123

OSC F (HOT)   9120

OSC B+   925

[illegible] TO P, GRID MTR   906

LINE FM 6 [illegible]   [illegible]

[illegible]   920 5

[illegible] TO [illegible]   9[illegible]

[illegible] TO KEY   95

TUNING			
	3.5	90	46
	3.6	85	41
	3.7	80	36
	3.8	75	31
	3.9	70	26
	4.0	65	21
	4.1	60	16
	4.2	56	12
	4.3	52	8
	4.4	48	3
	4.5	44	0

[illegible]

[illegible] 91 ✓

ALC 9 ✓ [illegible]

[illegible] 92 ✓

[illegible] 93 To [illegible], 930 ✓ [illegible]

[illegible] 6 ✓

[illegible] 95 ✓

[illegible] To [illegible] 905 ✓

KEYLINE

[illegible] To [illegible] ~~[illegible]~~ 906 ✓

([illegible])
T61 To KEYJACK [illegible] ✓

[illegible] ([illegible]) 20 ✓

-50 V To I2 [illegible] 925[illegible] ✓

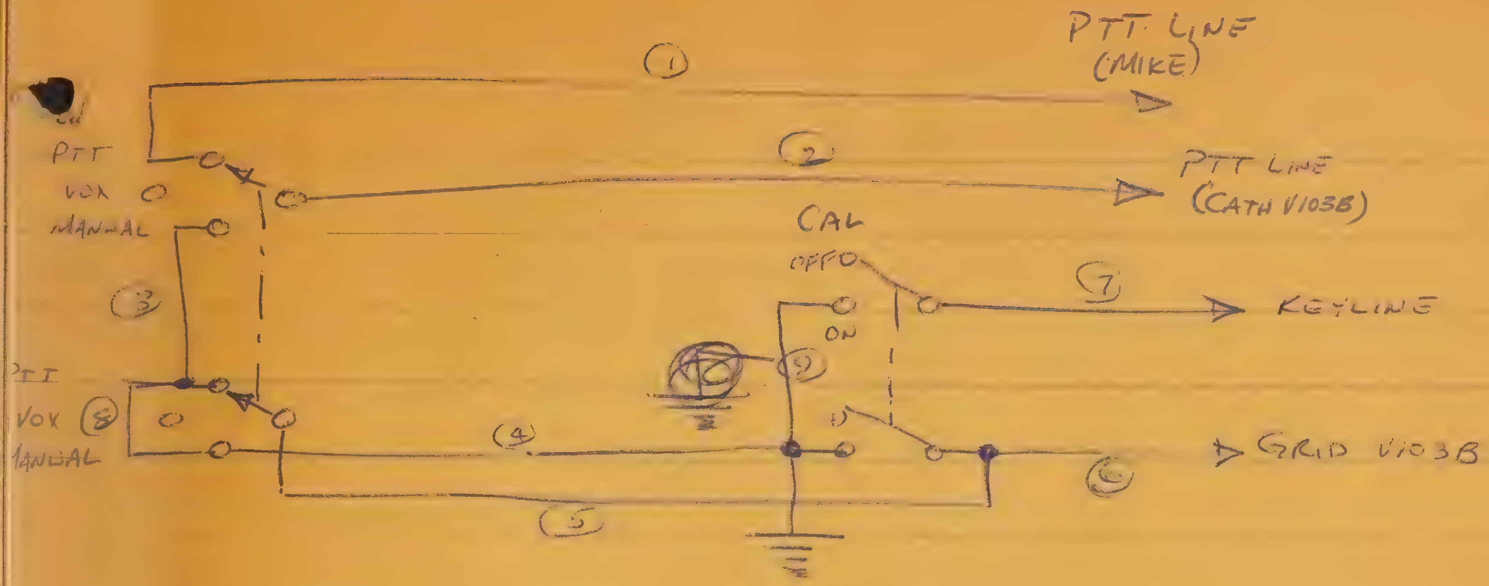
[illegible] - [illegible] 92~~55~~ 56 ✓

[illegible] To [illegible] 912[illegible] ✓

[illegible] ~~[illegible]~~ 925

-175 To [illegible] ~~926~~ 9132

PA [illegible] To [illegible] 926 ✓



① PRESENT
② PRESENT
⑥ PRESENT
⑦ PRESENT

③ ON SWITCH BACK
⑧ " " "
⑨ " " "

④ REQ'D RUN
⑤ REQ'D RUN

CABLE CONNECTIONS

	[illegible]WER SUP. END	XMTR END.
1.	———	OSC. FIL
2.	−150 V D.C.	−150 V DC
3.	OSC. FIL.	OSC. FIL.
4.	P.A. BIAS	P.A. BIAS
5.	6.3 V AC.	6.3 V A.C.
6.		
7.	H. VOLTAGE	
8.		H. VOLTAGE
9.	+210 V DC. REG.	+210 V DC. REG.
10.	P.A. PL. I MTR.	P.A. PL. I MTR.
11.	+ 300 V D.C.	+ 300 V D.C.
12.	ANT. RELAY +110 V D.C.	ANT. RELAY
13.	GND	GND
14.	COMMON A.C.	COMMON A.C.
15.	HOT A.C.	HOT A.C.

BARRIER STRIP CONNECTIONS [AUDIO CHASSIS]

1. PHONE PATCH OUTPUT
2. 500 Ω AUDIO
3. RCVR DISABLE
4. RCVR DISABLE
5. P.T.T. LINE
6. GND
7. KEYLINE INTERLOCK TO RELAY
8. KEYLINE INTERLOCK FROM RELAY
9. ANTENNA RELAY [+110 V. D.C.]
10. COMMON A.C.

TERMINAL STRIP CONNECTIONS [illegible]

NUMBER FROM LEFT

1 PTT LINE —

2 GND

3 SPKR GND

4 500 Ω AUDIO

5 } TELEPHONE LINE
6 }

7 } RCVR DISABLE
8 }

See "Operation Phone Patch" R.C. Muedke of Cedar Rapids
Dec. 1952 CQ Magazine

C.W.

XMT

PLATE VOLTAGE ON FINAL.	SW ON PWR SUPPLY
SCREEN VOLTAGE ON FINAL.	VOX RELAY CLOSED.
CARRIER INSERTED.	CARRIER INSERT POT
A.L.C. GROUNDED AUDIO IN OFF POSITION.	PERFORMED SIMULTANEOUSLY BY SWITCH ON AUDIO POT
EXCITER KEYING THROUGH C.W. KEY.	NORMALLY CLOSED JACK IN SERIES WITH KEY LINE & VOX RELAY CONTACTS
ANTENNA RELAY ACTUATED.	VOX RELAY CLOSED
RCVR DISABLED	VOX RELAY CLOSED

VOX RELAY TRIGGERED BY GROUNDING CATHODE V103B
PROBABLY WITH FOOT OPERATED SWITCH. IN PTT CIRCUIT

RCV

PLATE VOLTAGE ON FINAL	SW ON PWR SUPPLY
SCREEN VOLTAGE OFF FINAL	VOX RELAY OPEN. CATHODE V103 B UNGROUNDED.
EXCITER NOT KEYED.	[KEY OPEN ∴ BIAS TO CUTOFF ON MIXER & DRIVER]
ANTENNA RELAY OPEN.	VOX RELAY OPEN
RCVR ACTUATED.	VOX RELAY OPEN

SSB — Xmt.

Plate Voltage On Final. Switch On Plate Supply

Screen Voltage On Final. Thru Vox Relay

Rcvr Disabled. Thru Vox Relay

Antenna Relay Actuated. Thru Vox Relay

Exciter Keyed. Thru Vox Relay

Audio Inserted. Audio Pot [illegible] Open

Carrier Removed. Carrier Insert Pot @ Min

A.L.C. Active. Sw. On Audio Pot

Rcv

Plate Voltage On Final [illegible] Pwr Supply

Screen Voltage On Final Off. Perhaps Neg. Volt Applied

Rcvr Activated.

Antenna Relay In Rcv (Unactuated) Position.

A.M.

Xmt.

Same As SSB Except Carrier Inserted.
P.T.T Ckt Might Be Used.

Rcv

Same As SSB

CAL

Vox Deactivated
(Grid V103B Gnd'd.
Thru Cal. Pos. Switch)
For Audio On
Cal. Just Talk.

Pl. Voltage On Final

Screen Voltage On Final Removed

Rcvr Active

Exciter Keyed. Not Thru Normal Circuit] Key Line Grounded Thru Cal. Pos. Switch.

Carrier Inserted. Not Inserted For Zero In.

Antenna Relay In Rcv [Unactuated] Position

SSB — XMT.

PLATE VOLTAGE ON FINAL. SWITCH ON PWR SUPPLY
SCREEN VOLTAGE ON FINAL. THRU VOX RELAY
RCVR DISABLED. THRU VOX RELAY
ANTENNA RELAY ACTUATED. THRU VOX RELAY
EXCITER KEYED. THRU VOX RELAY
AUDIO INSERTED. AUDIO POT PARTIALLY OPEN
CARRIER REMOVED. CARRIER INSERT POT @ MIN
A.L.C. ACTIVE. SW. ON AUDIO POT

RCV

PLATE VOLTAGE ON FINAL SW ON PWR SUPPLY
SCREEN VOLTAGE ON FINAL OFF. PERHAPS NEG. VOLT APPLIED
RCVR ACTIVATED.
ANTENNA RELAY IN RCV (UNACTUATED) POSITION.

A.M.

XMT.

SAME AS SSB EXCEPT CARRIER INSERTED.
P.T.T CKT MIGHT BE USED.

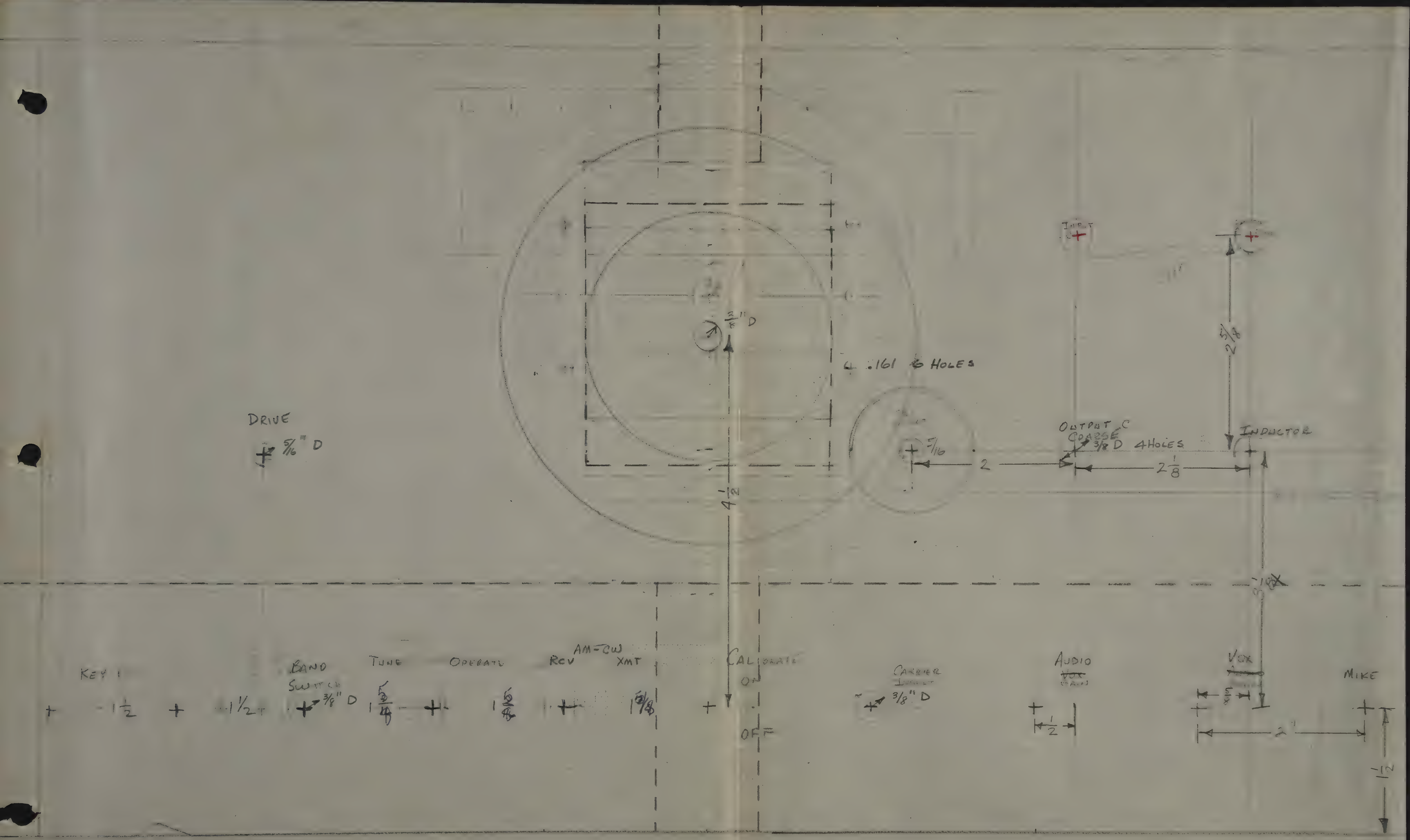
RCV

SAME AS SSB

CAL

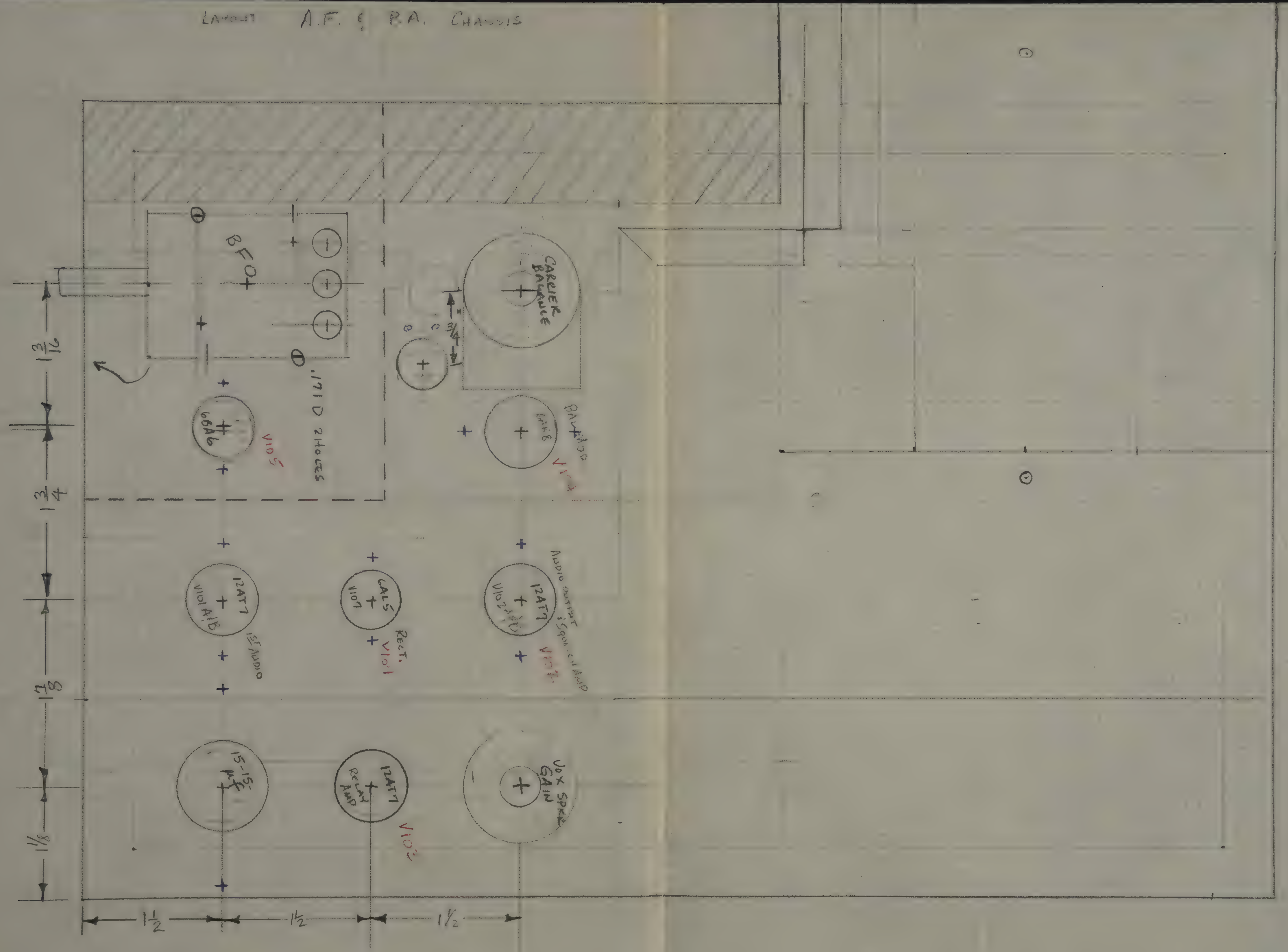
VOX DEACTIVATED
(GRID V103B GND'DG.
THRU CAL. POS. SWITCH)
FOR AUDIO ON
CAL. JUST TALK.

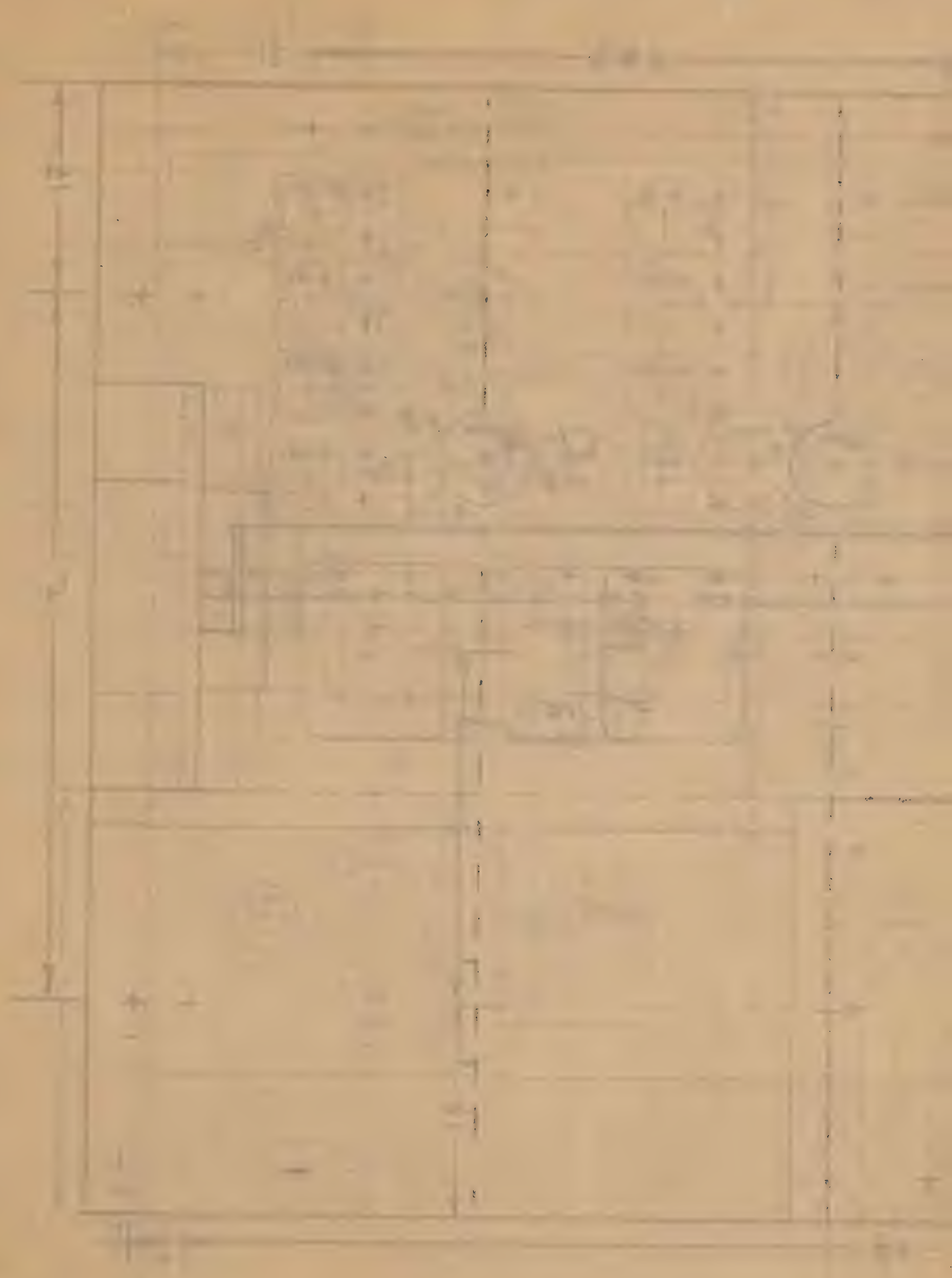
SW PWR SUP PL. VOLTAGE ON FINAL
ON SCREEN VOLTAGE ON FINAL REMOVED
RCVR ACTIVE
EXCITER KEYED. [NOT THRU NORMAL CIRCUIT] KEY LINE GROUNDED THRU CAL. POS. SWITCH.
CARRIER INSERTED. NOT INSERTED FOR ZERO IN.
ANTENNA RELAY IN RCV [UNACTUATED] POSITION



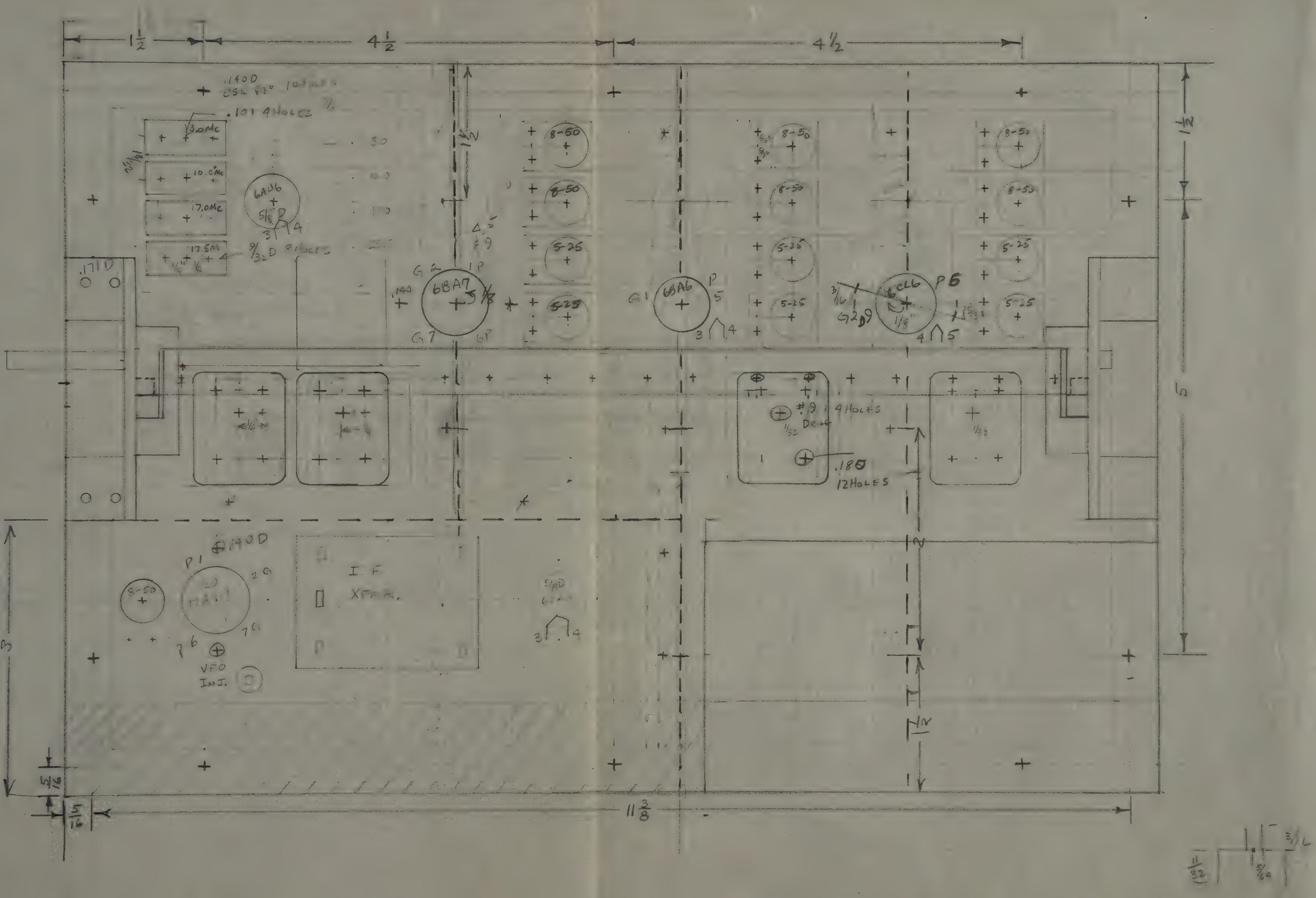
THIS DRAWING NOT TO SCALE

LAYOUT A.F. & R.A. CHASSIS

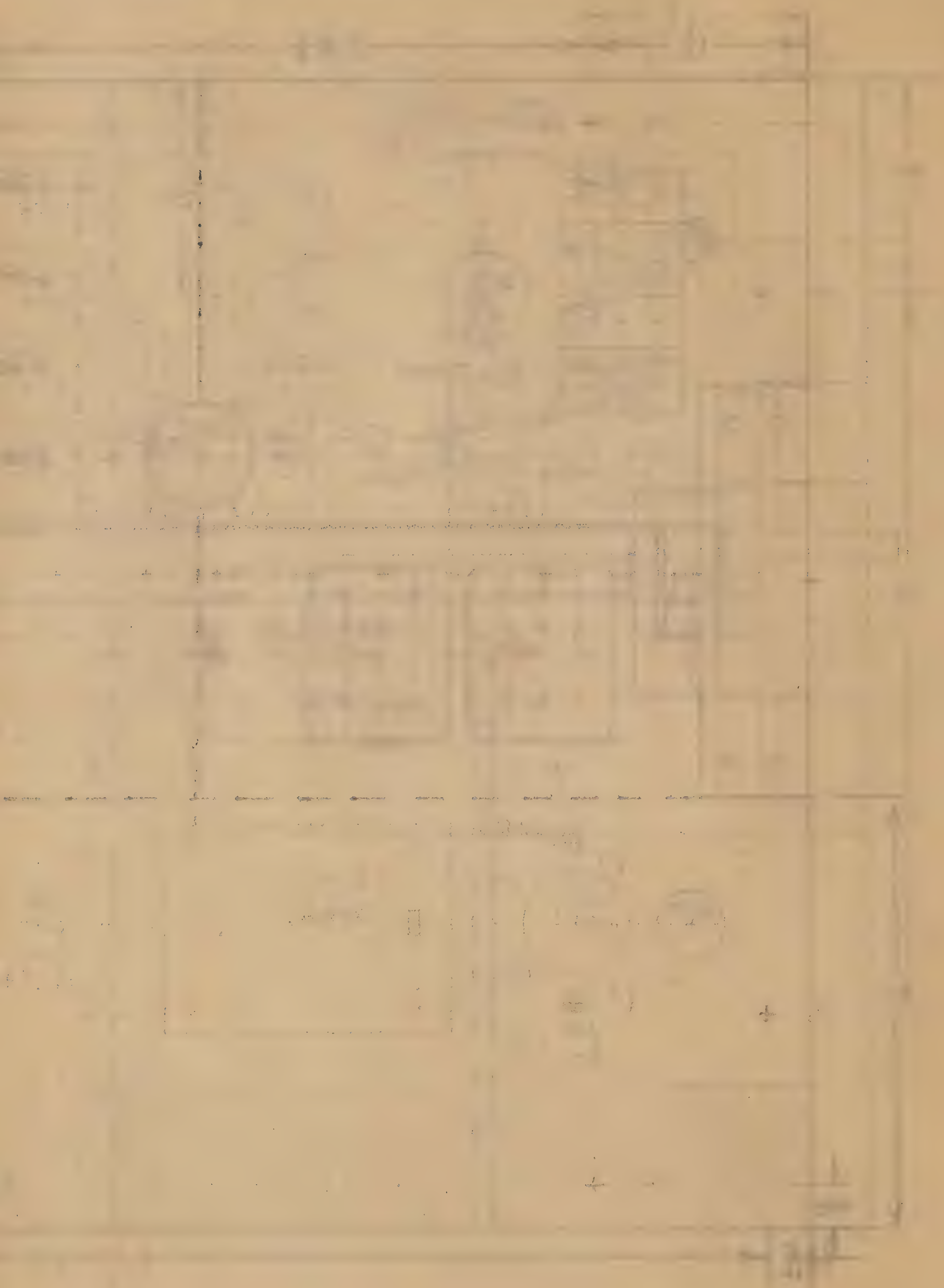




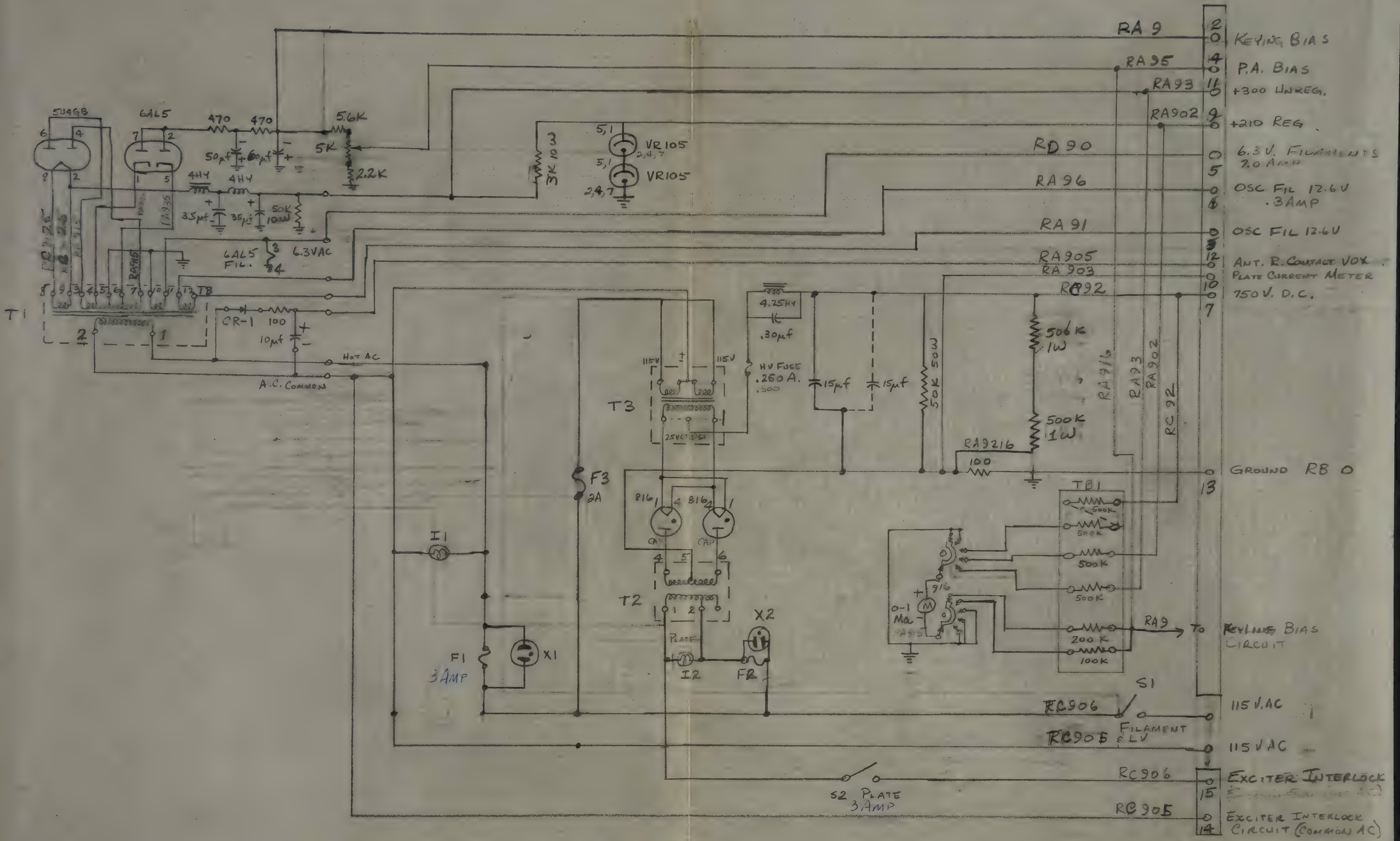
EXCITER R.F. STAGES, CHASSIS LAYOUT



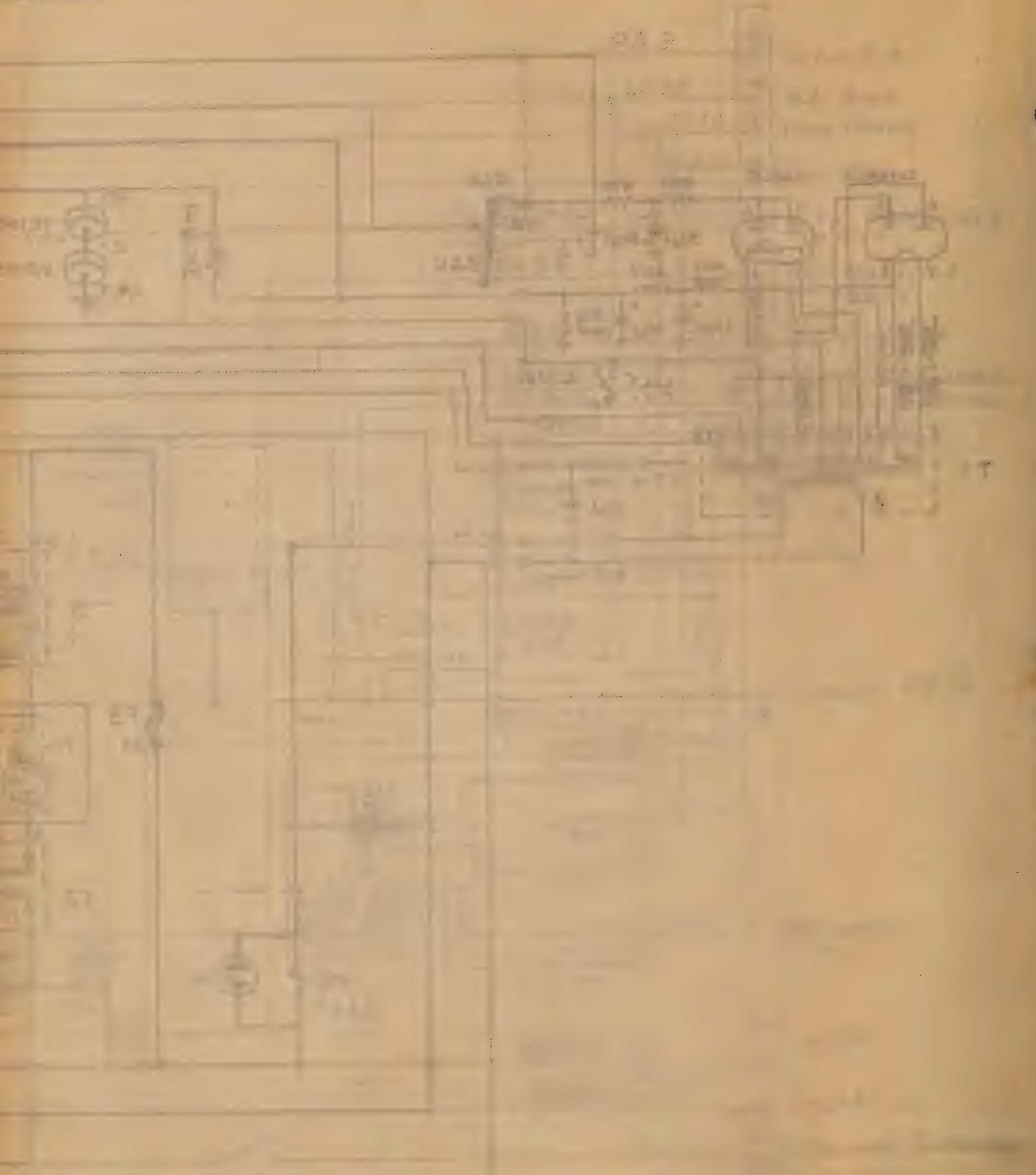
SCALE 1"=1"



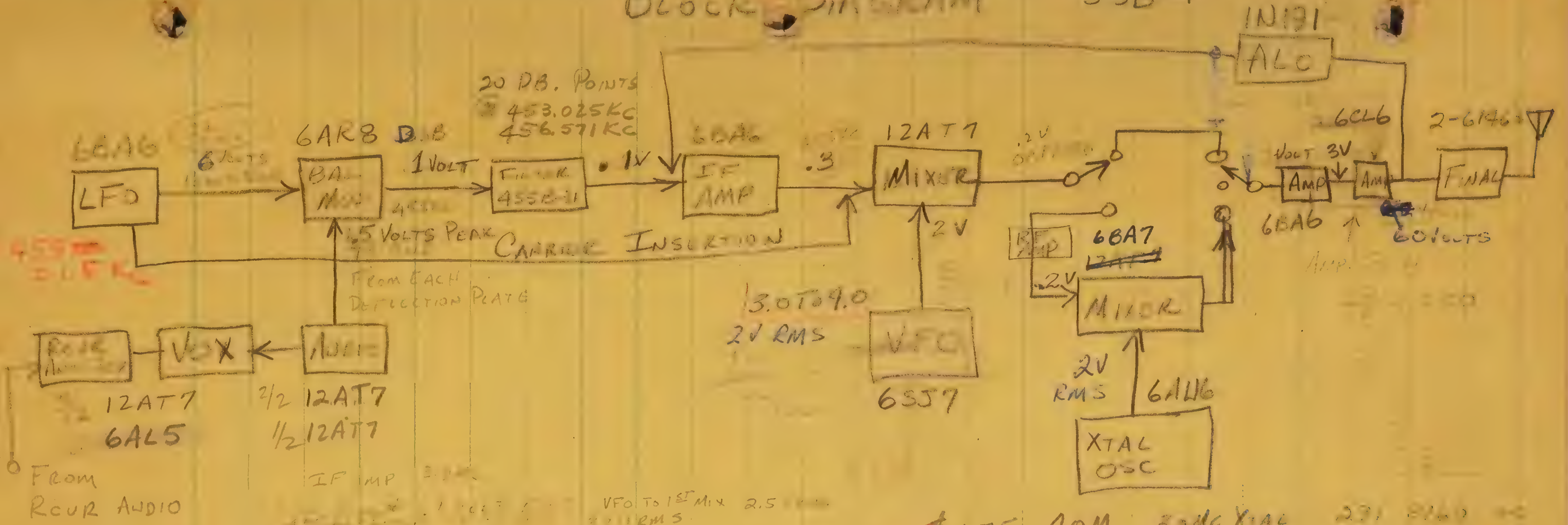
POWER SUPPLY SSB-1



stems



BLOCK DIAGRAM SSB-1



~~$~~ 1.75	40M	3.0MC XTAL	291 8160 00
~~$~~ 2.75	20M	10.0 " "	291 8133 00
$ 2.08 $ 1.85	15M	17.0 " "	290 0074 00
$ 1.12	10M	12.5 " "	290 0017 00

L.F.O. TUNED CIRCUIT TO USE MODIFIED BFO UNIT 278 0091 00

I.F. AMP OUTPUT FED INTO MODIFIED I.F. TRANSF. 278 0061 00

80M MIXER OUTPUT TO BE TRACKED BY MEANS OF SLUG RACK.

80M DRIVER OUTPUT " " " " " " "

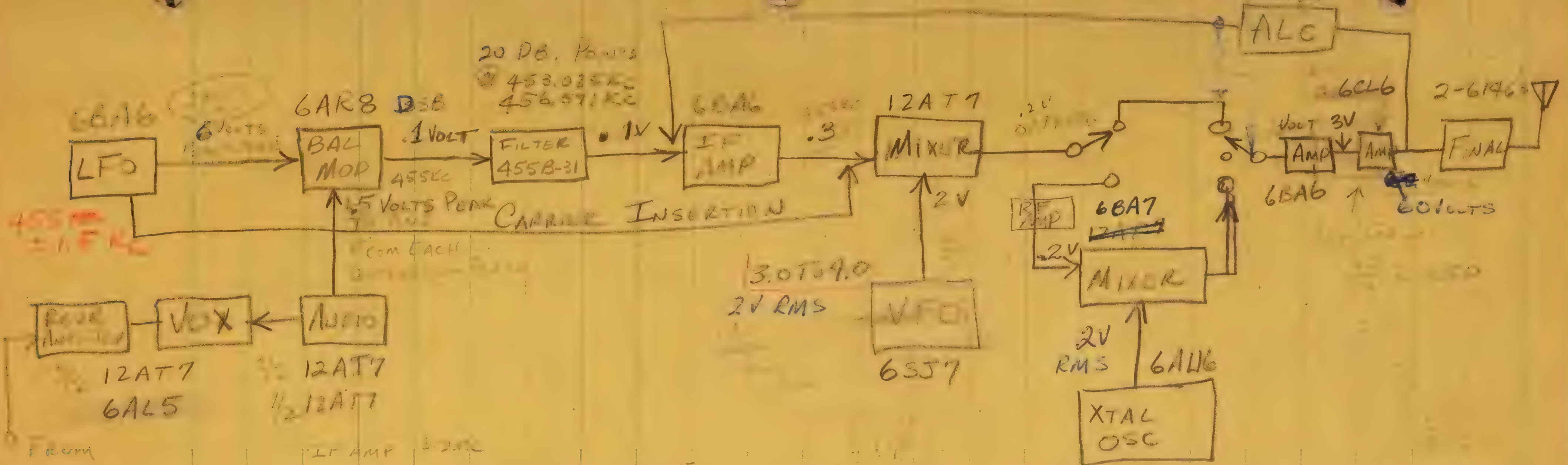
A 6BA6 OPERATING FREQ. AMPLIFIER TO BE ADDED AHEAD OF DRIVER; OUTPUT TO BE TRACKED

CAPACITY COUPLING TO BE USED BETWEEN STAGES. [SEE [illegible]]

6146 OUTPUT TO BE TUNED BY MEANS OF PI-NETWORK

$\frac{\Delta f}{f} = .114$ 4 TUNED CIRCUITS OF Q=50 ATTEN = 83DB
3 " " " " " = 64DB

BLOCK DIAGRAM SSB-1



IF AMP 6BA6 Input .1 VOLT RMS VFO TO 1ST MIX 2.5 VRMS

A .75	40M	3.5MC XTAL	291 [illegible]
A 2.75	20M	10.0" "	291 5138
#1.80	15M	17.0" "	[illegible]
#1.73	10M	12.5" "	290 0017

L.F.O. TUNED CIRCUIT TO USE MODIFIED BFO UNIT 278 [illegible]

I.F AMP OUTPUT FED INTO MODIFIED I.F. TRANSF. 278 [illegible]

80M MIXER OUTPUT TO BE TRACKED BY MEANS OF SLUG RACK.

80M DRIVER OUTPUT " " " " " " " "

A 6BA6 OPERATING FREQ. AMPLIFIER TO BE ADDED AHEAD OF DRIVER OUTPUT TO BE TRACKED

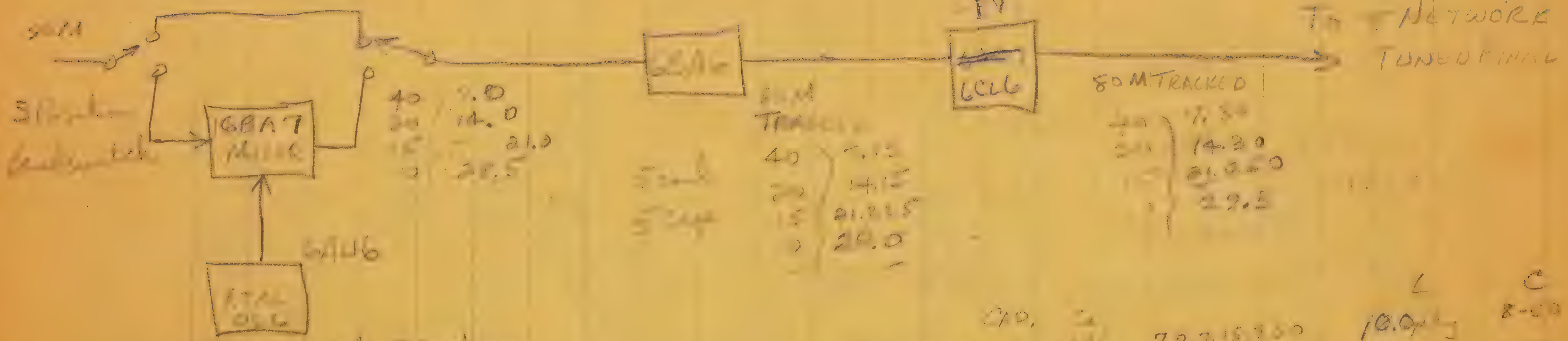
CAPACITY COUPLING TO BE USED BETWEEN STAGES. [50Ω LINK TO FINAL]

6146 OUTPUT TO BE TUNED BY MEANS OF PI-NETWORK

$\frac{\Delta f}{f} = .114$ 4 TUNED CIRCUITS OF Q=50 ATTEN = 83DB

3 " " " " " " = 64DB

5 secs bandswitch   5 secs bandswitch   5 Pos bandswitch



XTAL 2 sect bandswitch 5 Positions

5.0 Mc – 40 | 5.0 40
10.0 Mc – 20 | 10.0 20 } Fixed Tuned
17.0 Mc – 15 | XTAL 17.0 15
12.50 – 10 | 25.0 10 } Tracks W/ XTAL

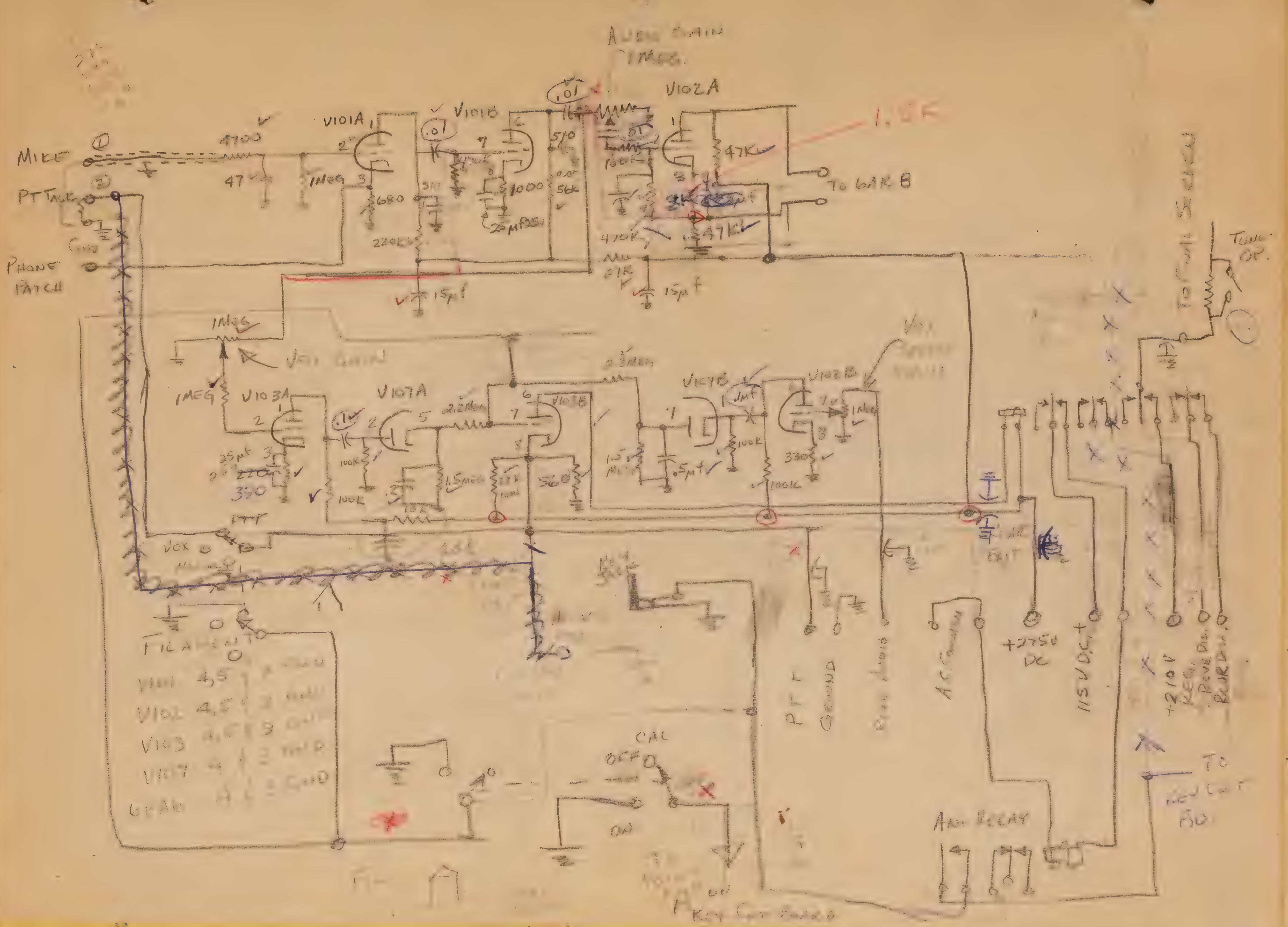
CAP.		$		L	C
			7.0, 7.15, 7.30	10.0 μhy	8-50
917	1075	.291	14.0, 14.15, 14.30	2.7 μh	8-50
			21.0, 21.xxx, 21.350	1.5 μhy	5-25
917	1073	.291	28.5, 29.0 29.5	1.0 μhy	5-25
				0.68 μhy	

6 Sections of 5 Position Bandswitch Reqd.

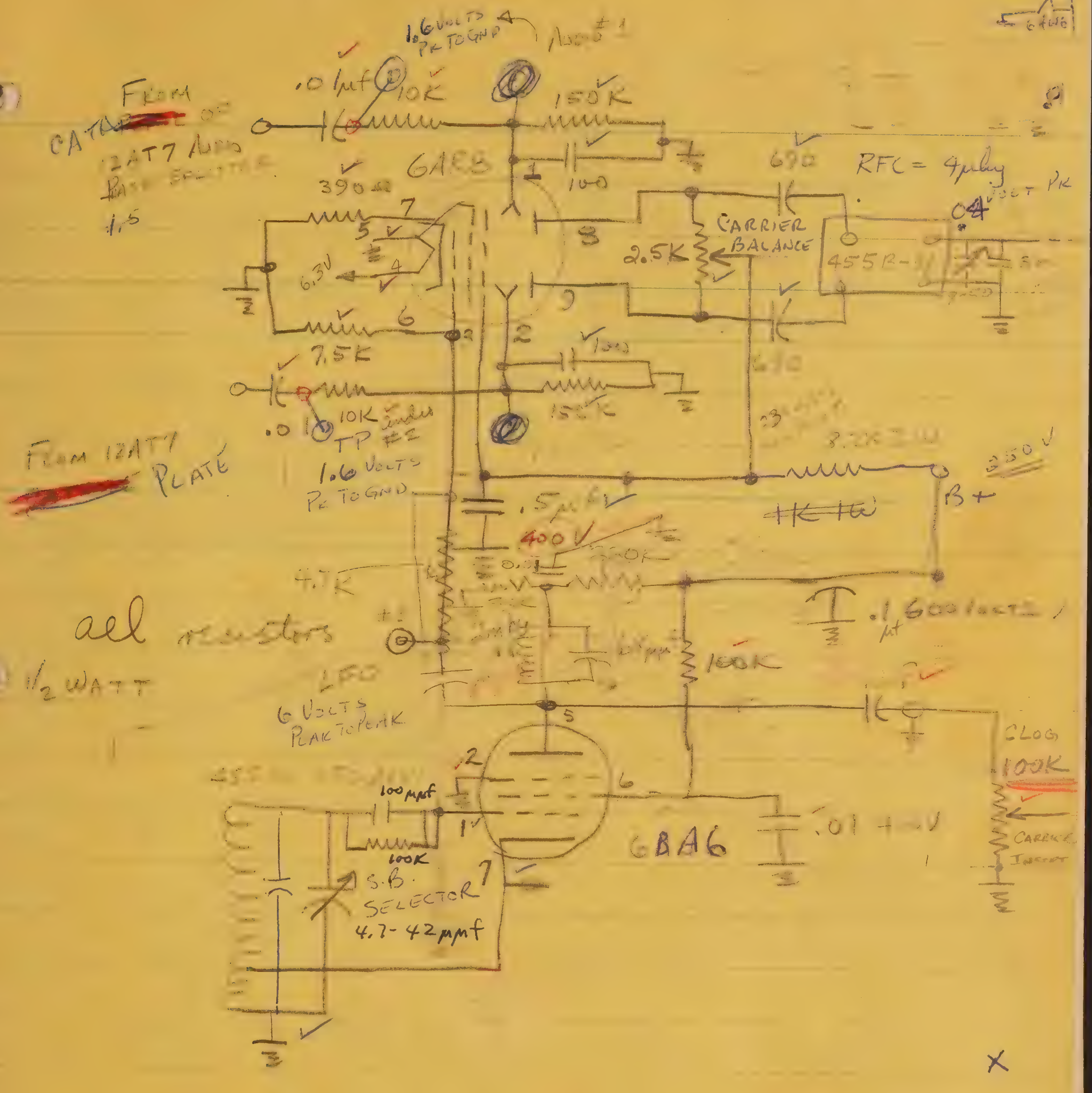
Propose to use 8-50 Variable ceramic for 40, 20, 80 tanks
4-25 Variable ceramic for 15 + 10 tanks

8-50 917 1075 00 $.291 each 8 Reqd ≈ $5.00
5-25 917 1073 00 .291 each 8 Reqd

AUDIO [illegible] & CONTROL CIRCUITRY

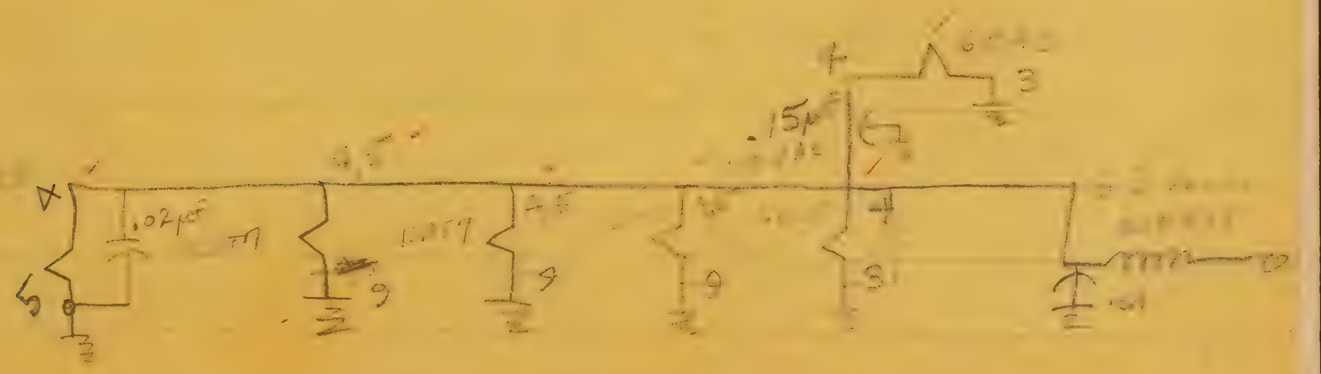


③ SSB MODULATOR

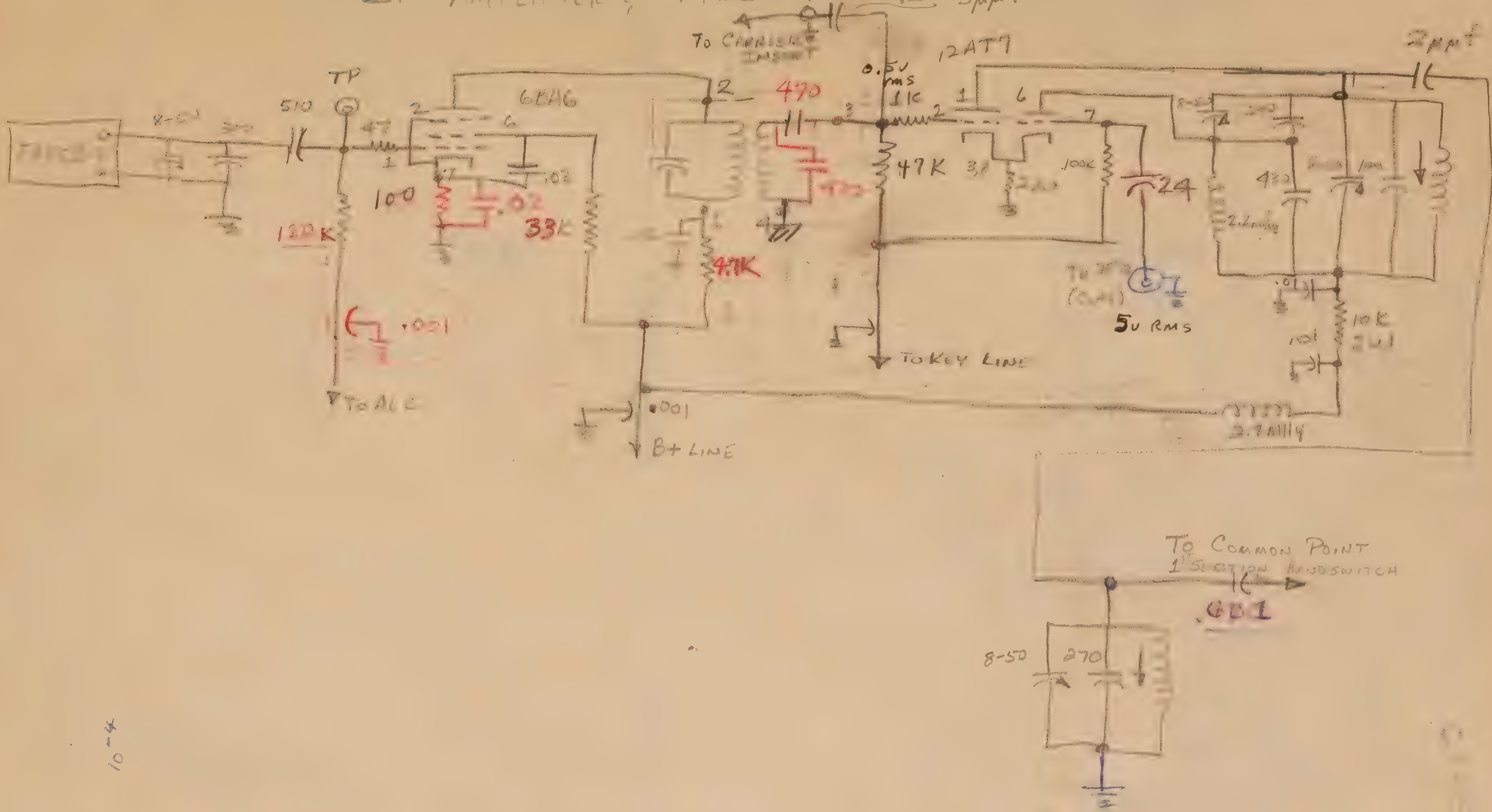


all resistors 1/2 WATT

X

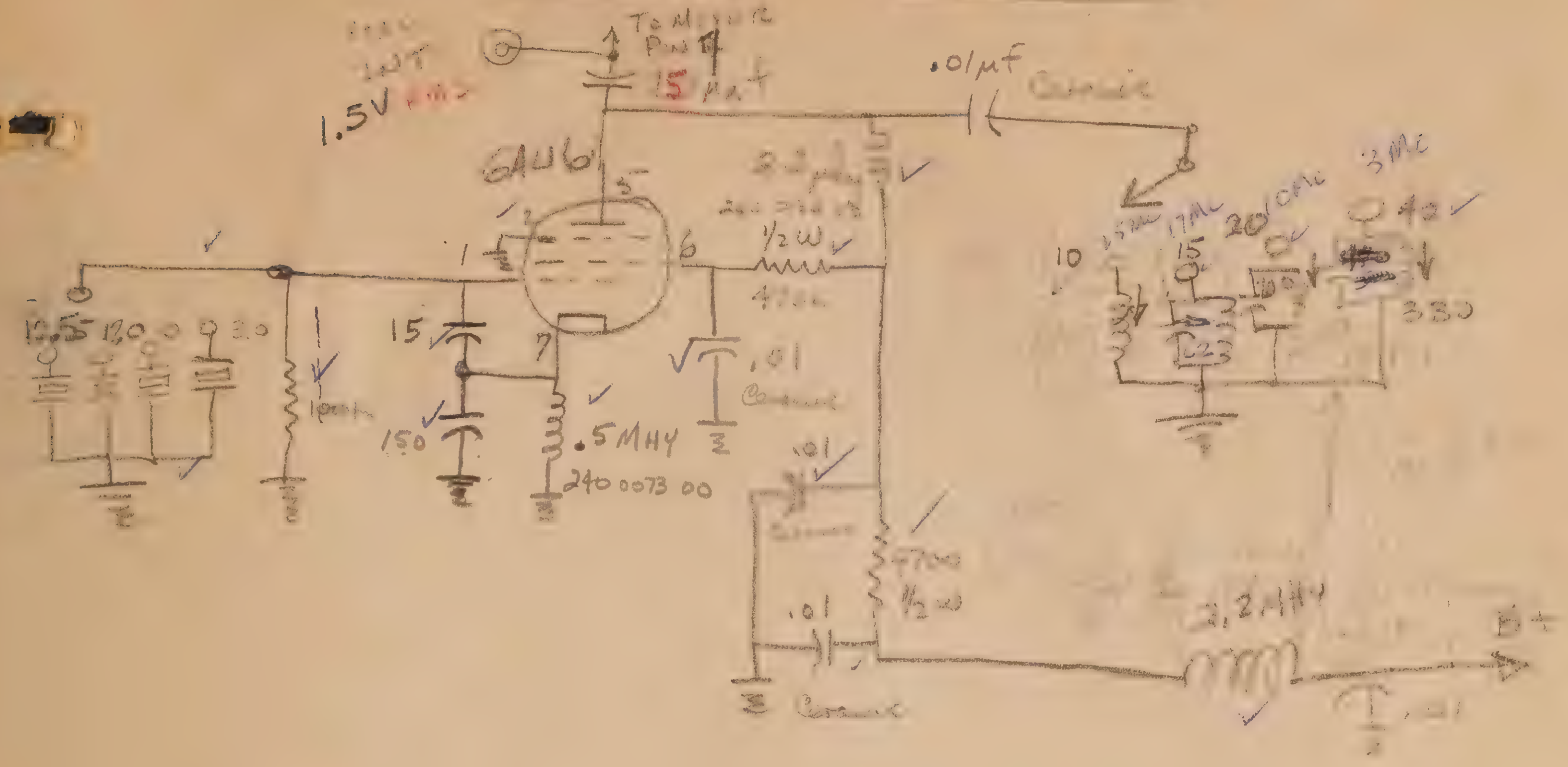


IF AMPLIFIER & FIRST MIXER



10^{-4}

(5) CONVERSION OSCILLATOR



PARTS LIST

RESISTORS

100K
470K
4700

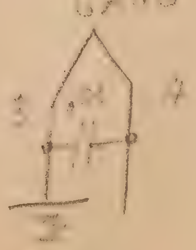
CAPACITORS

15
150
② 5
④ .01 500V
20
75
470
1000 μμf

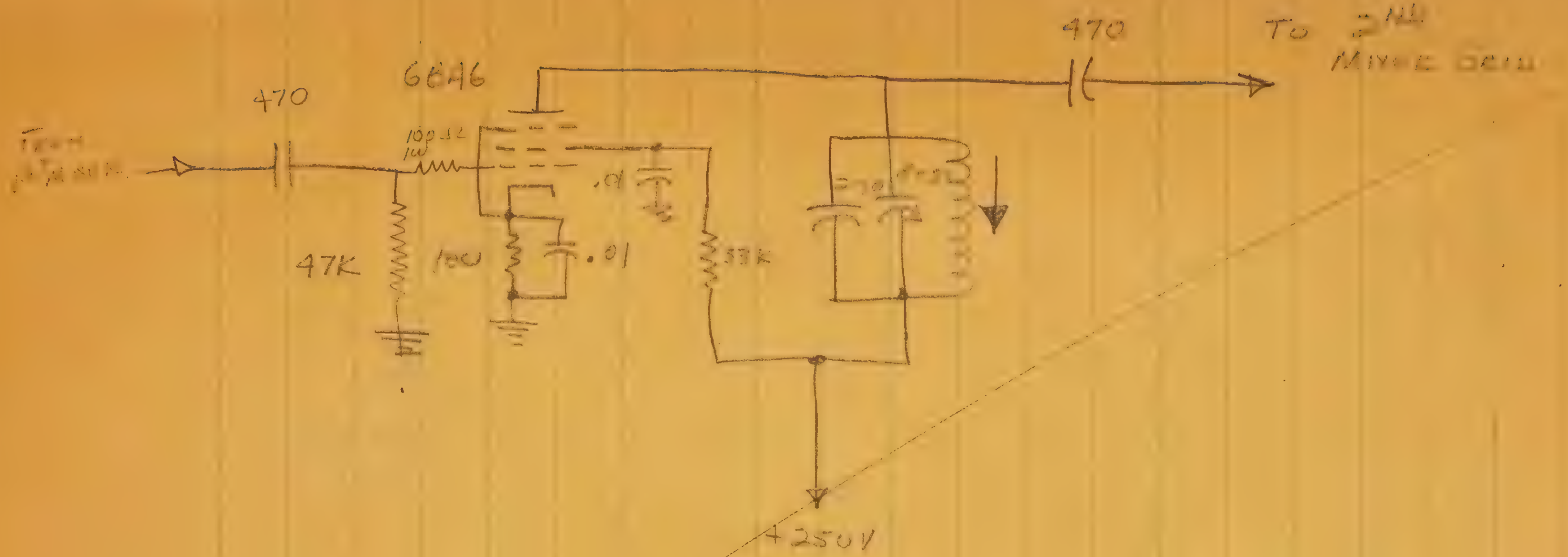
CHOKES

	.5 MHY	240 0073 00
②	2.2 MHY	240 0174 00

TUBE
6AU6
7 PIN SOCKET
TUBE SHIELD



R.F. AMP 40 – 10 METER BANDS



To be [illegible] only
In [illegible] [illegible]

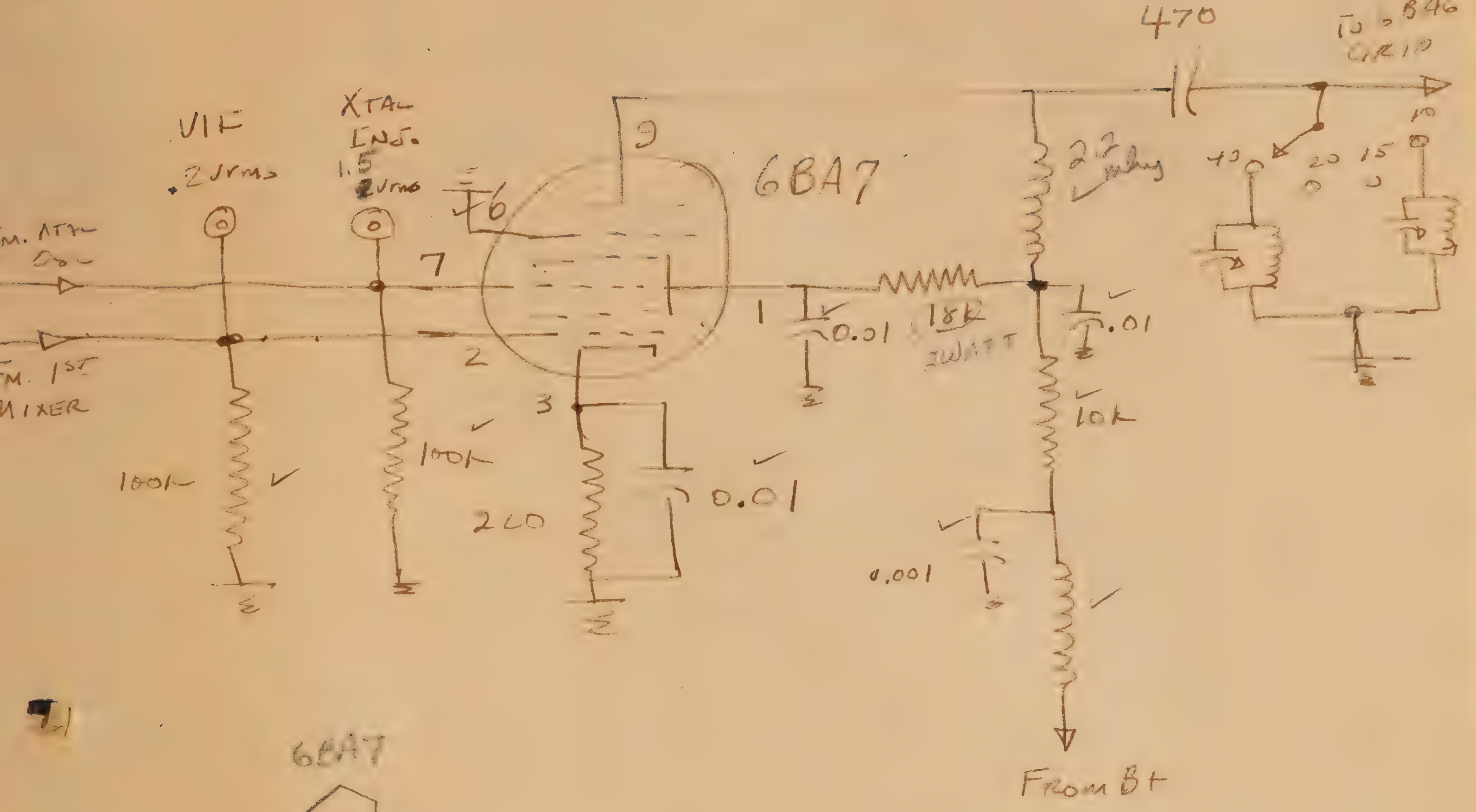
2ND MIXER

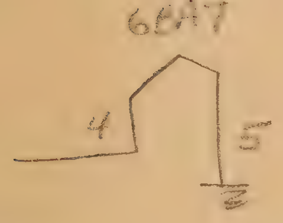
DESIGN FIG:

$E_b = 250$

$E_{sg} = 100$

$E_k = 3V$

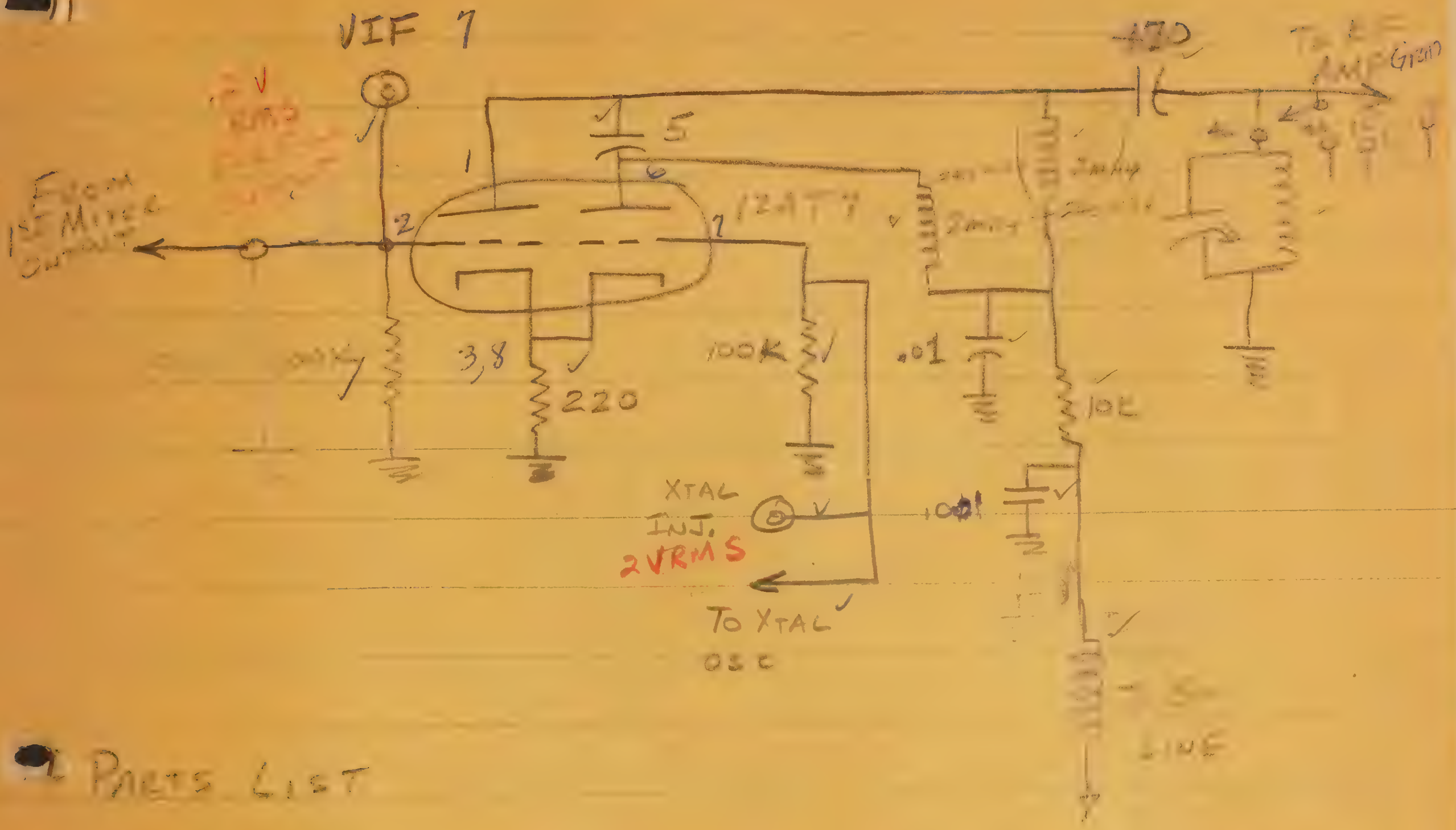




If we go replace
with 6X8.
Use triode as inj.
Pentode as mixer.

⑥

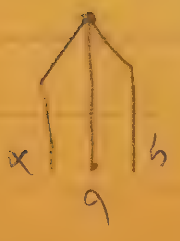
2ND MIXER

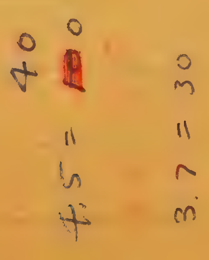


PARTS LIST

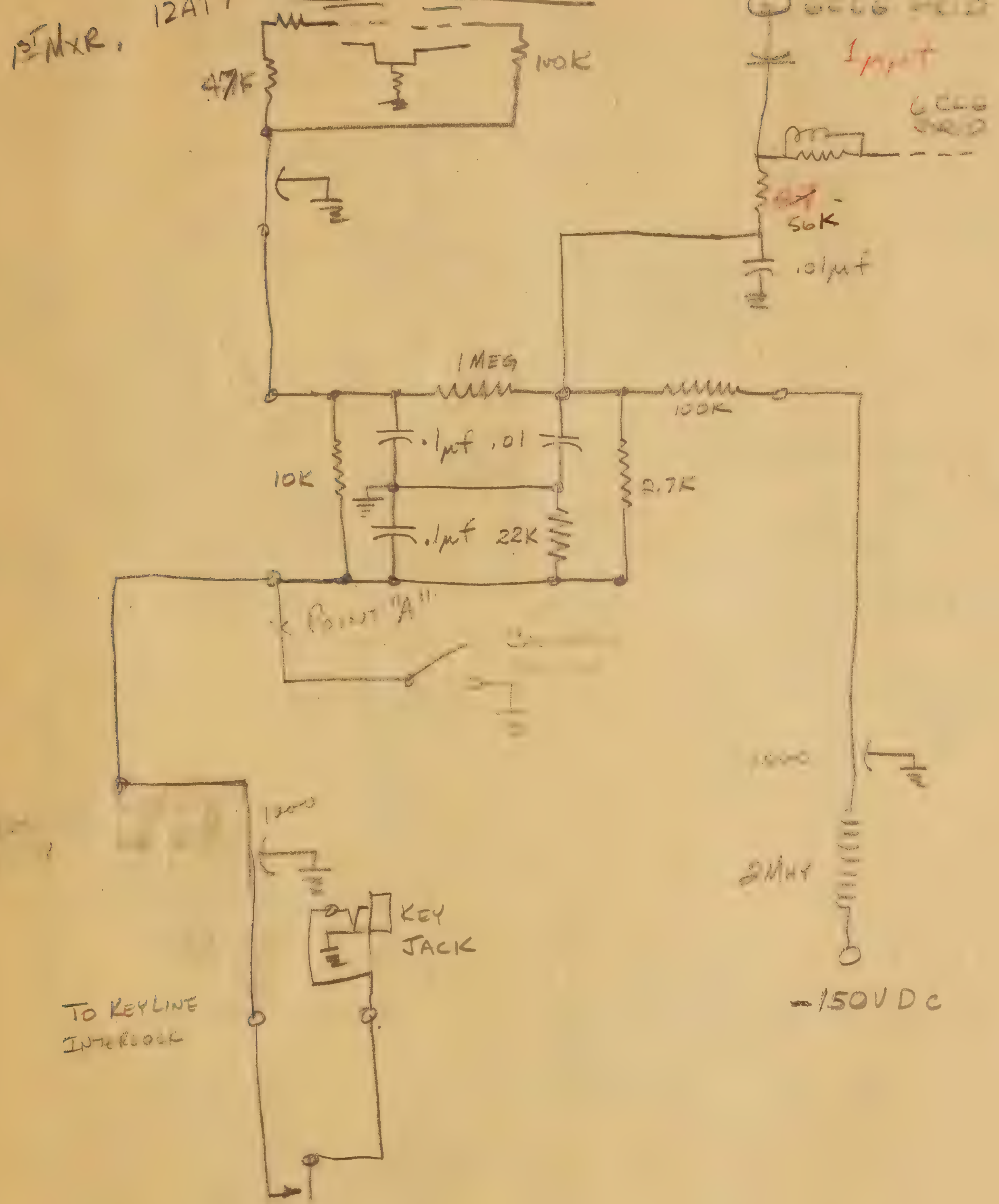
RESISTORS	CAPACITORS	CHOKES
~~470~~	~~3~~	③ [illegible]
220	5	1 ~~[illegible]~~ 10 μhy
③ 100K	.01 [illegible]	1 2.7 μhy
10K	.01 400	1 1.5 μhy
	10	1 ~~[illegible]~~ [illegible]
	② 8-50 VAR	
	② 5-25 VAR	

Replaced by
6BA7

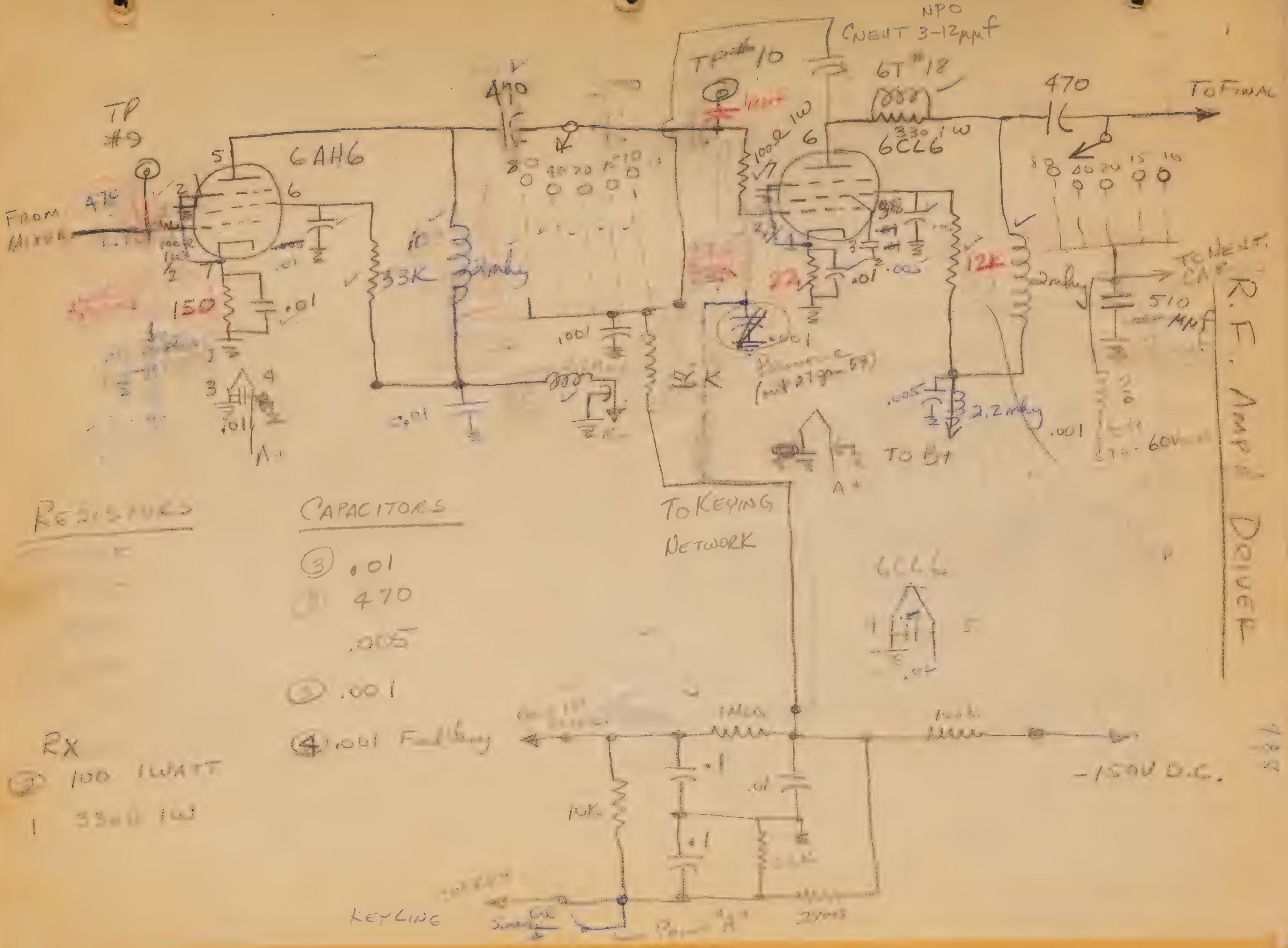




KEYING CIRCUIT



R. F. AMP & DRIVER



RESISTORS

RX

(2) 100 1WATT

1 330Ω 1W

CAPACITORS

(3) .01

470

.005

.001

(4) .001 Feed Thru

FINAL

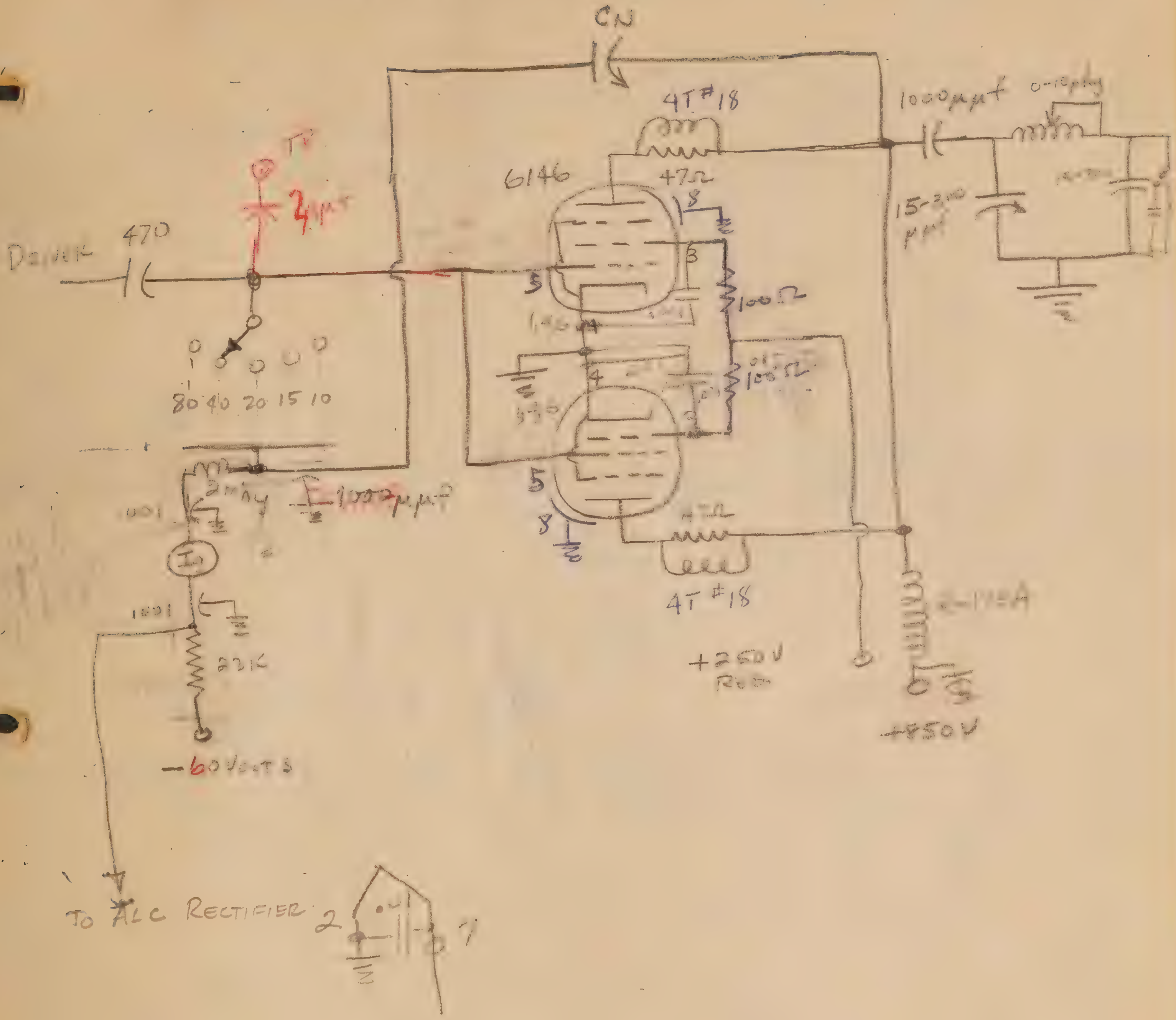
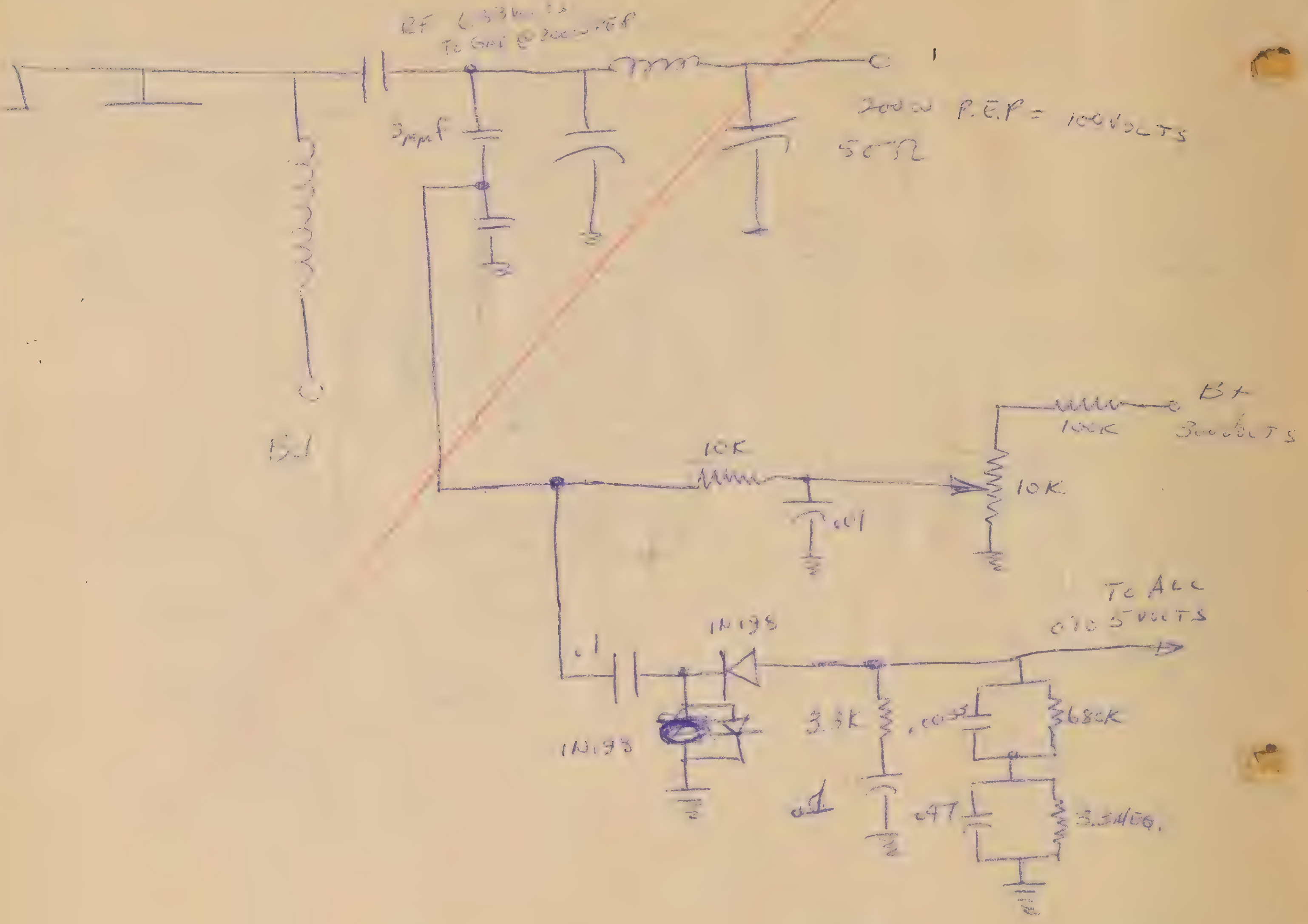
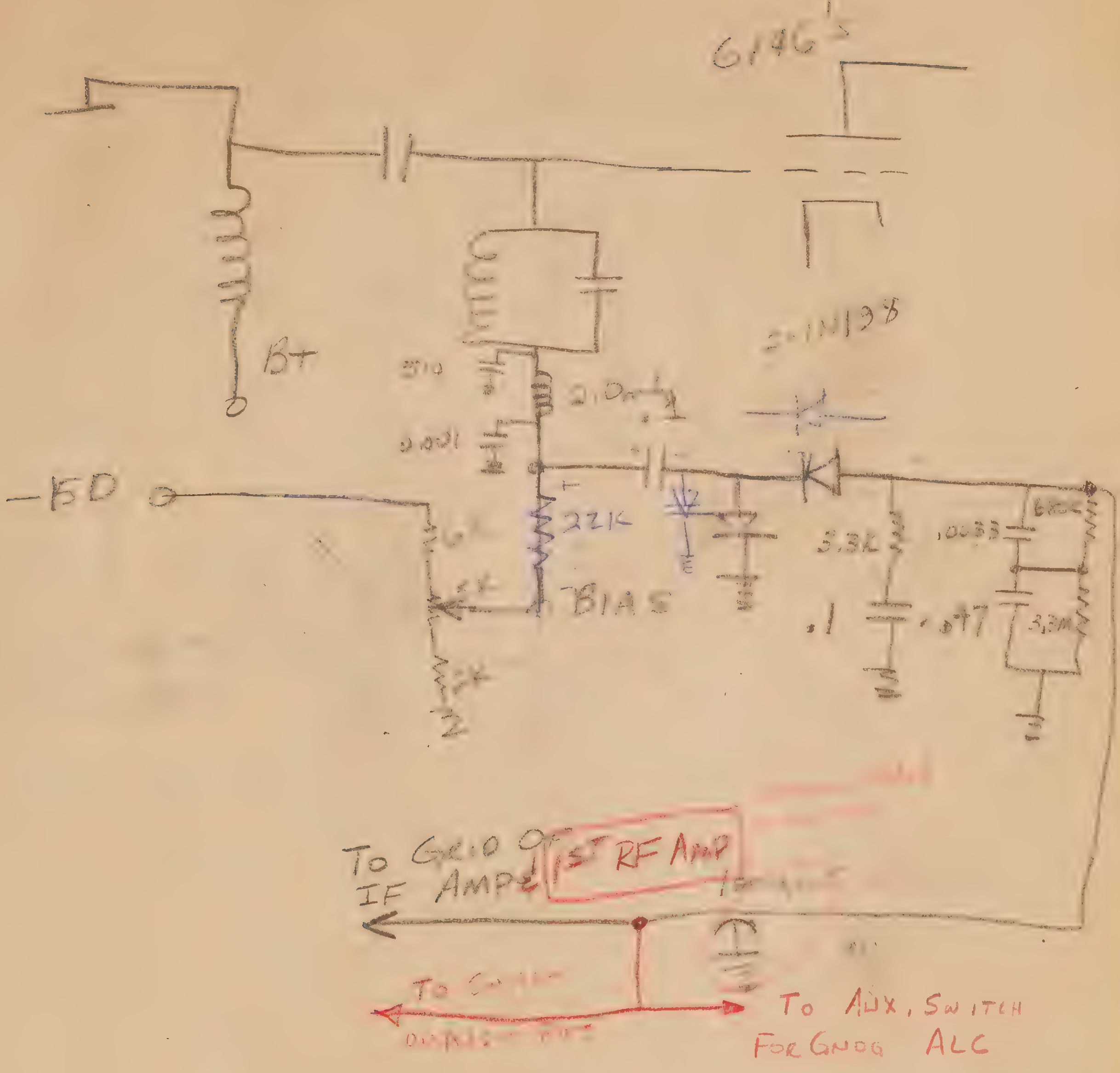

CN
4T #18
1000μμf
0-10μhy
6146
47Ω
8
15-300 μμf
Driver
470
TP
2μμf
3
100Ω
80 40 20 15 10
4
100Ω
5
2mhy
.001
1000μμf
I₁
8
47Ω
4T #18
.001
22K
-60 Volts
+250V Reg
+850V
To ALC Rectifier
2
1

PLATE CIRCUIT ALC



Not Drawn

GRID CIRCUIT ALC



PARTS LIST

RESISTORS

3.3K
680K
3.3 MEG

CAPACITORS

② .1 μf
.001 μf
.0033 μf
.47 μf
1000 μf

TUBE

2 1N34 Diodes

VOLTAGES TO GROUND, SET IN CAL, NO AUDIO.

6BA6 R.F. AMP

1	2	3	4	5	6	7	8	9
0	0	0	6.3AC	260	130	+1.5	—	—

6CL6 RF AMP

1	2	3	4	5	6	7	8	9
	-3.5 -1.5 ~~-2.8~~	+220	0	6.3AC	275	0	+220	-2.8

12AT7 AUDIO AMP

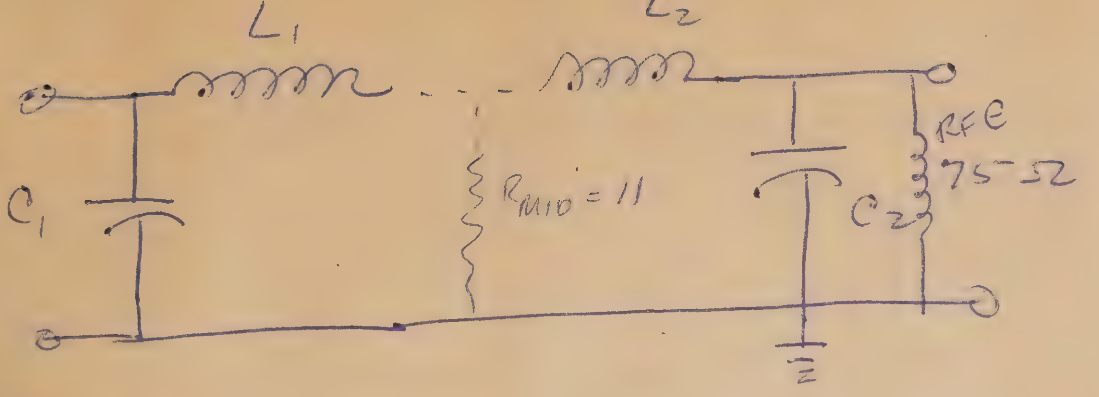
1	2	3	4	5	6	7	8	9
+46	0	+0.4	6.3AC	6.3AC	+105	0	+1.6	0

12AT7 AUDIO AMP, SQUELCH AMP

1	2	3	4	5	6	7	8	9
+200	+40	+80	6.3AC	6.3AC	+84	0	+0.6	0

12AT7 VOX & RELAY AMPLIFIER

1	2	3	4	5	6	7	8	9
+82	0	+0.4	6.3AC	6.3AC	+275	0	+8.4	0



$Q \cong 15$

$X_{L_1} = X_{C_1} = 150\ \Omega$

$X_{L2} = 26$

$X_{C2} \cong 31$

3.5 Mc

$C_1 = 300\mu\mu f$

$C_2 = 1470\mu\mu f$

$L_1 = 6.8\mu hy$

$L_2 = 1.2\mu hy$

$L_{TOT} = 8.0\mu hy$

7.0 Mc

$C_1 = 150\mu\mu f$

$C_2 = 735\mu\mu f$

$L_1 = 3.4\mu hy$

$L_2 = .6\mu hy$

$L_{TOT} = 4.0\mu hy$

14.0 Mc

$C_1 = 75\mu\mu f$

$C_2 = 367.5\mu\mu f$

$L_1 = 1.7\mu hy$

$L_2 = .3\mu hy$

$L_{TOT} = 2.0\mu hy$

28.0 MC

$C_1 = 37.5\mu\mu f$

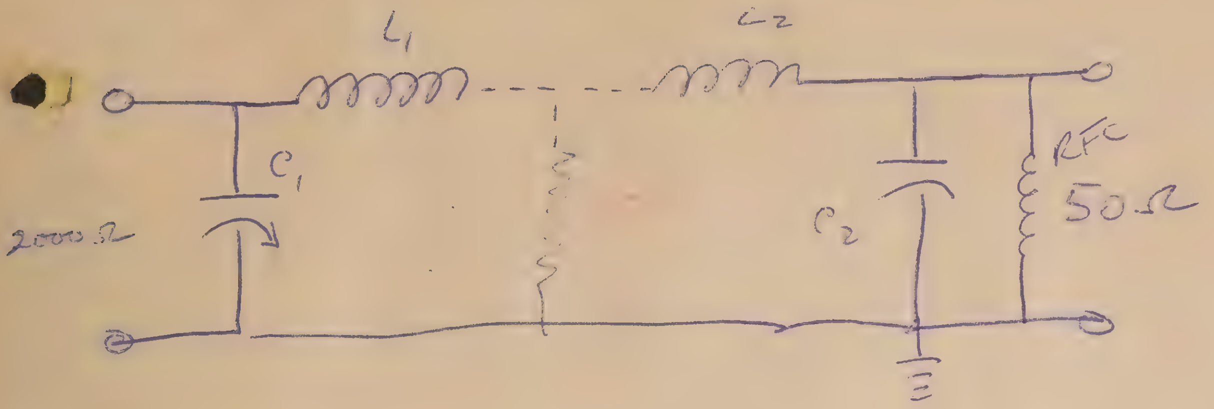
$C_2 = 183.8\mu\mu f$

$L_1 = .85\mu hy$

$L_2 = .3\mu hy$

$L_{TOT} = 1.0\mu hy$

PARALLEL 6146's PLATE RESISTANCE ≈ 2,000 Ω



$Q = 14$

$X_{L_1} = X_{C_1} = 150\,\Omega$

$X_{L_1} = X_{C_1} = 165\,\Omega$ FOR $R_{PLATE} = 2500\,\Omega$

$X_{L_2} = 2\overset{1}{\textcircled{2}}\,\Omega$

$X_{C_2} = 27\,\Omega$

3.5 Mc	C_1 = 300 μμf	L_1 = 6.8 μhy	L_{TOT} = 7.8 μhy
	C_2 = 1690 μμf	L_2 = 1.0 μhy	
7.0 Mc	C_1 = 150 μμf	L_1 = 3.4 μhy	L_{TOT} = 3.9 μhy
	C_2 = 845 μμf	L_2 = .5 μhy	
14.0 Mc	C_1 = 75 μμf	L_1 = 1.7 μhy	L_{TOT} = 1.95 μhy
	C_2 = 422.5 μμf	L_2 = .25 μhy	
21.0 Mc	C_1 = 50 μμf	L_1 = 1.13 μhy	L_{TOT} = 1.30 μhy
	C_2 = 281.6 μμf	L_2 = .17	
28.0 Mc	C_1 = 37.5 μμf	L_1 = .85 μhy	L_{TOT} = .975
	C_2 = 211.25 μμf	L_2 = .125	

MEASUREMENTS ON E.F. JOHNSON 10μhy Coil

Inductance	Turns		C	
8.5μhy	n = 16		100%	
		6		4
4.25μhy	n = 10		50%	
		3.4		1/8
2.125μhy	n = 6.6		25%	
		1.85		1/8 rev
1.45μhy	n = 4.75	1.38	12.5%	
1.0625μhy	n = 3.37			

1.85
1.38
3.23

1/4 Rev CAP = 6 turns inductor. 3.5 TO 7.0 Mc

1/8 Rev CAP = 3.4 turns inductor. 7.0 to 14.0 Mc

1/8 Rev Cap = 3.23 turns inductor. 14.0 to 28.0 Mc

Average value 6 + 6.8 + 6.46 = 19.3/3 = 6.4

6.8
6.0
6.5
19.3

6.4 turns per 1/4 Rev of Cap.

12.8 turns and 1/2 rev cap.

USE 12.5 turns Inductor per 1/2 rev cap.

∴ # TEETH CAPACITOR GEAR = 25 X # TEETH INDUCTOR

DUMMY ANTENNA MEASUREMENTS

$f = 3.8$ Mc
$R_p = 46.5$

$$X_{C_p} = \frac{10^6}{(6.28)(3.8)C} = \frac{42 \times 10^3}{C}$$

$$X_{C_p} = \frac{42 \times 10^3}{41} = 1025$$

$f = 7.2$ Mc
$R_p = 47.0$

$$X_{C_p} = \frac{10^6}{(6.28)(7.2)C} = \frac{22.2 \times 10^3}{C} = \frac{22.2}{40.7} \times 10^3$$

$$X_{C_p} = 544$$

$f = 14.2$ Mc
$R_p = 49.0$

$$X_{C_p} = \frac{10^6}{6.28(14.2)C} = \frac{11.2}{C} \times 10^3 = \frac{11.2}{38.0} \times 10^3$$

$$X_{C_p} = 295$$

$f = 29.0$ Mc
$R_p = 56.5$

$$X_{C_p} = \frac{10^6}{6.28(29)C} = \frac{5.5}{29.3} \times 10^3 = 188$$

$f = 50$ / $X_{C_1} =$ [illegible] $=$ [illegible]

SWR

$$Z_1 = \frac{46.5(1025)^2}{(46.5)^2 + (1025)^2} - j\,\frac{1025(46.5)^2}{(46.5)^2 + (1025)^2} = 46.5 + j2.1 \qquad 1.05:1$$

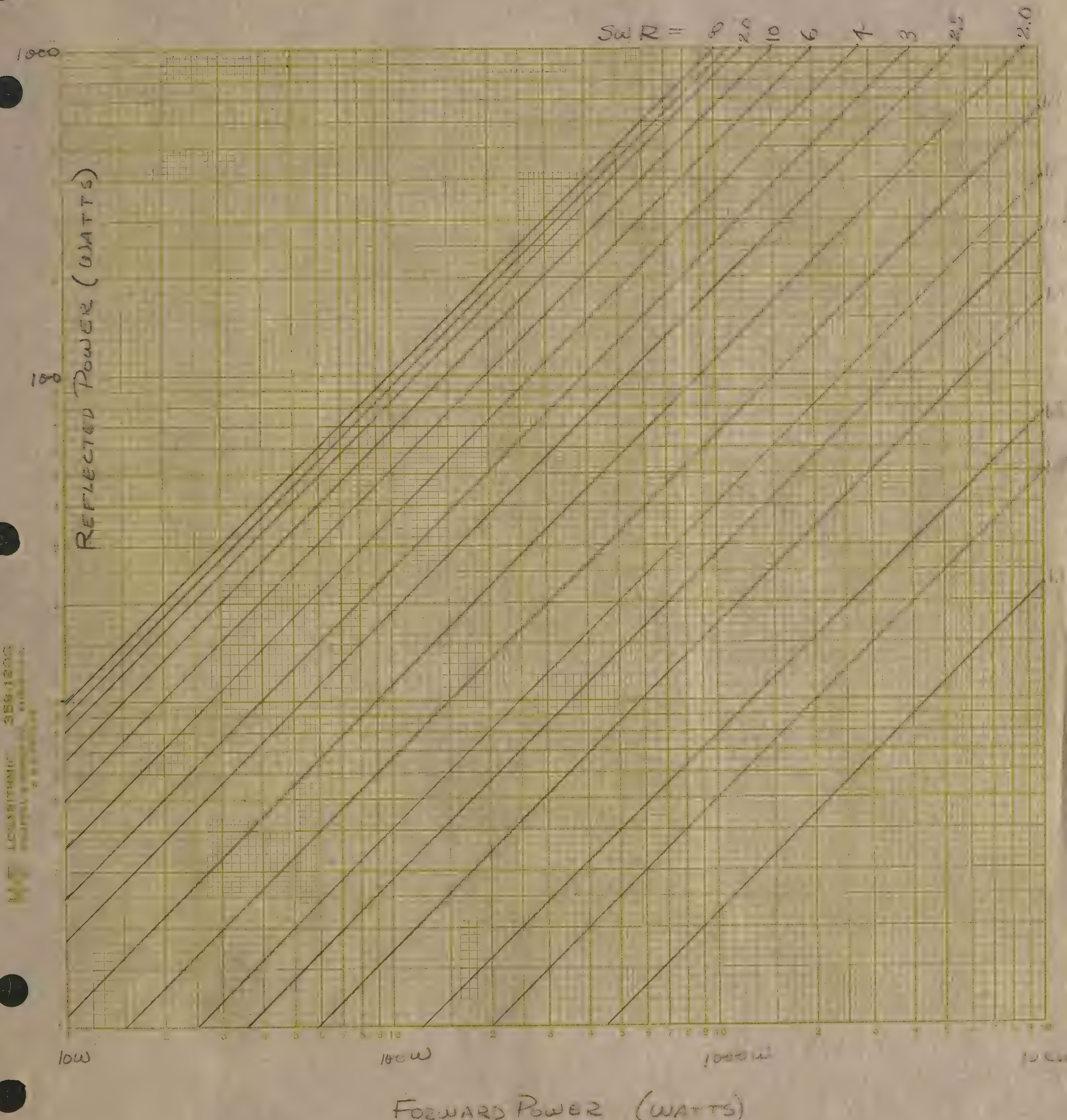
$$Z_2 = \frac{47.0\,(544)^2}{(47.0)^2 + (544)^2} + j\,\frac{544\,(47.0)^2}{(47.0)^2 + (544)^2} = 46.7 + j4.0 \qquad 1.1:1$$

$$Z_4 = \frac{56.5\,(188)^2}{(56.5)^2 + (188)^2} + j\,\frac{188(56.5)^2}{(56.5)^2 + (188)^2} = 51.3 + j15.6 \qquad 1.35:1$$

$$Z_3 = \frac{49.0\,(295)^2}{(49)^2 + (295)^2} + j\,\frac{295\,(49)^2}{(49)^2 + (295)^2} = 47.8 + j10.6 \qquad 1.2:1$$

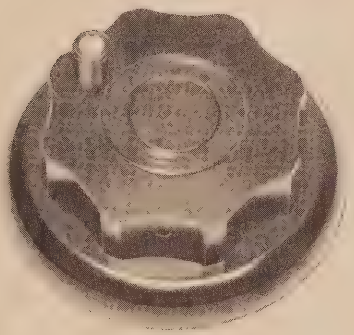
$$Z_5 = \frac{74\,(200)^2}{(74)^2 + (200)^2} + j\,\frac{200(74)^2}{(74)^2 + (200)^2} = 65 + j23.3$$ [illegible]

RELATIONSHIP OF SWR
TO FORWARD & REFLECTED POWER



INSTRUCTION BOOK

COLLINS VERNIER TUNING KNOB



COLLINS RADIO COMPANY
CEDAR RAPIDS, IOWA

520 5430 00
2nd EDITION
1 SEPT., 1956

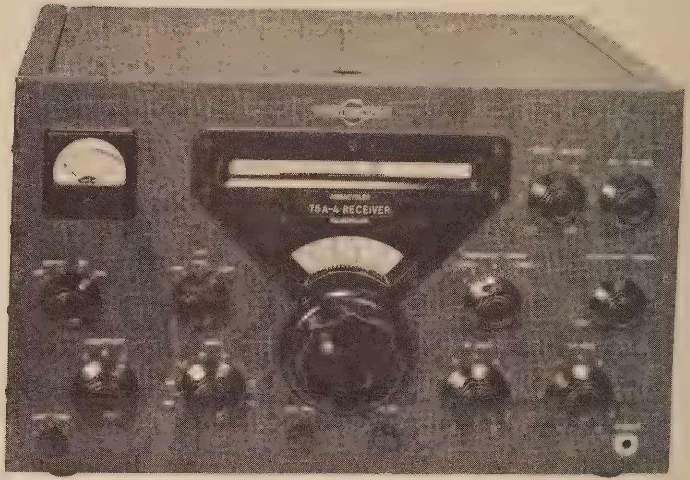


Figure 1. Tuning Knob Mounted on 75A-4 Receiver

I. GENERAL DESCRIPTION

The Vernier Tuning Knob (Collins part number 541 6291 00) is specifically designed for use with the Collins 75A-4 Receiver; however, it is perfectly adapted for use with such other units as the KWS-1, 75A-2, and 75A-3. The only requirement is that the shaft to be turned is 1/4 inch in diameter and that it protrudes at least 7/8 inch from the front panel.

The tuning knob is made of black plastic. The gearing mechanism is constructed of brass, aluminum, stainless steel, and other corrosion-resistant materials. The construction is such that it can be readily taken apart for cleaning and lubricating. The gears are machine-cut and spring loaded to eliminate backlash and are designed to obtain a 4 to 1 speed reduction.

II. INSTALLATION ON A TYPE 75A-4 RECEIVER.

The Vernier Tuning Knob is shipped in two pieces; the vernier mechanism and the knob. Check the knob and ring gear to make certain the setscrews are in place. If they are missing, search the packing material.

Use the following procedure to install the Vernier Tuning Knob Assembly.

1. Refer to figure 2. Using the knob setscrew wrench included with the original purchase of the 75A-4 Receiver, remove the old tuning knob to expose the tuning shaft front bearing plate.

2. Remove the two screws securing the front bearing plate and save them. Screws for installations other than the 75A-2, 3, and 4 are furnished with the knob. Slide the front bearing plate off the tuning shaft and discard it. The frame of the vernier mechanism of the new knob includes a new front bearing for the tuning shaft.

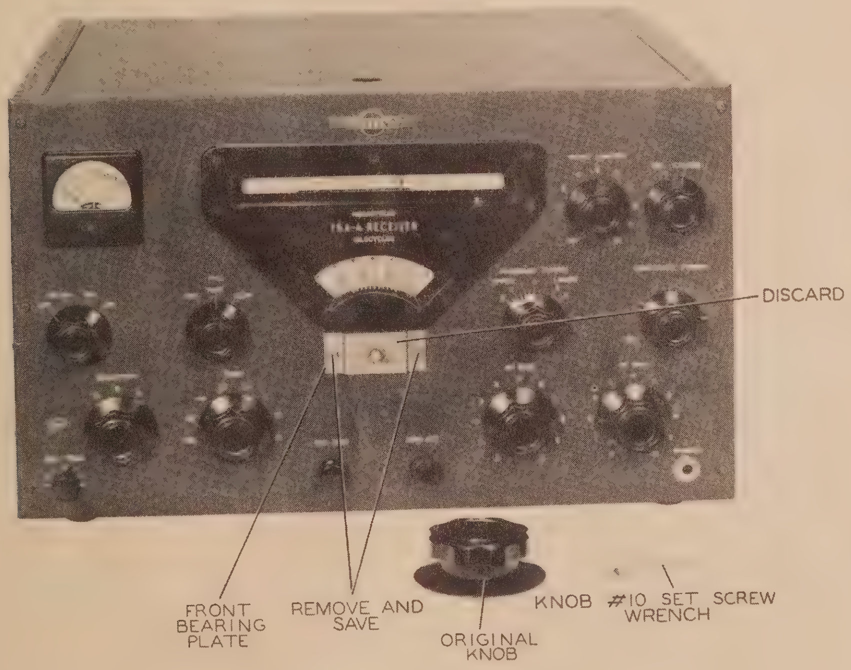


Figure 2. Step 1

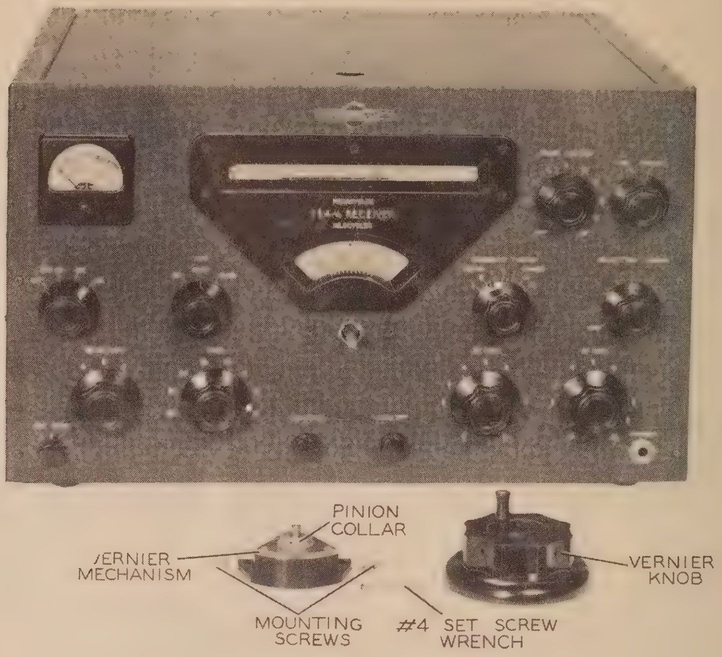


Figure 3. Step 2

3. Figure 3 shows the parts necessary to install the new tuning knob. Arrange these parts as shown and set all others aside.

4. Refer to figure 4. Enter the tuning shaft into the ring gear hole and slide the vernier mechanism back to where the tuning shaft is about to enter the frame bearing. Carefully press the frame downward until the bearing in the frame is aligned with the tuning shaft then slide the frame onto the shaft. (Because of the antibacklash spring, the frame bearing will not ordinarily be aligned with the tuning shaft until a small amount of pressure is exerted.) Slide the assembly back on the tuning shaft and align the two mounting holes with the old bearing plate mounting holes. Insert the bearing plate mounting screws which were saved and tighten them. Slide the ring gear back until there is about 1/32 inch clearance between the back of the ring gear and the frame casting. If the ring gear is not positioned correctly, it will not clear the shim washer located behind the pinion gear and backlash may result. Tighten the two shaft setscrews. Turn the ring through several revolutions to make sure it does not rub anywhere.

5. Place the new tuning knob onto the knob shaft (shown in figure 4). Slide the knob on the shaft as far as it will go and tighten the two setscrews.

6. Release the DIAL DRAG knob. It is no longer used.

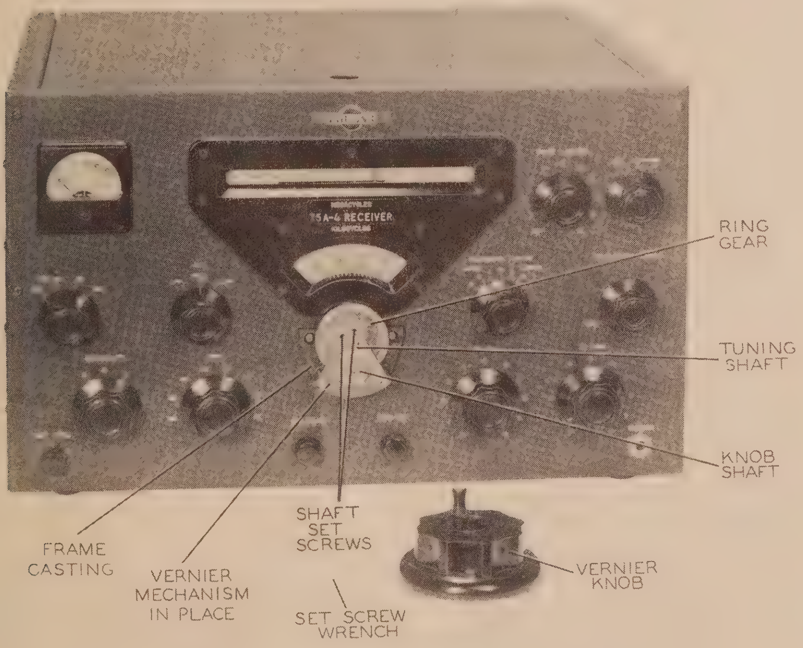


Figure 4. Step 3

III. MAINTENANCE

1. LUBRICATION.

If, at any time, the knob loses its smoothness or begins to feel toothy, there is a possibility that the lubricant has become dirty or dried out. Remove the entire assembly from the receiver and wash the vernier mechanism in carbon tetrachloride or gasoline. Clean out the back of the tuning knob with a clean lintless cloth. Coat the ring gear teeth with a thin film of light grease such as Lubriplate, or Vaseline. Disassemble the pinion from the pinion collar by releasing the two collar setscrews and withdrawing the pinion shaft. Wash the parts in carbon tetrachloride then reassemble after first coating them with the light grease. Squeeze the pinion and the pinion collar together and tighten the setscrews. Assemble the remainder of the knob.

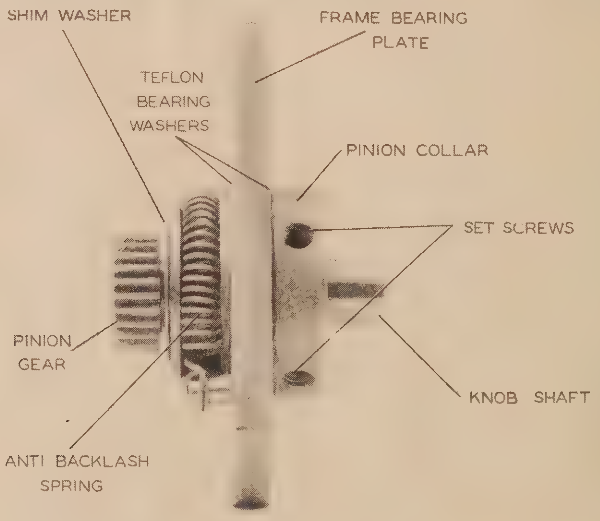


Figure 5. Vernier Mechanism, Right Side View

2. ADJUSTMENT.

If the tuning knob feels wobbly, remove the knob, release the pinion collar setscrews (see figure 5) and squeeze the pinion and pinion collar together then tighten the setscrews and replace the knob. If the tuning knob binds as it is rotated, remove the knob. release the pinion collar setscrews (see figure 5) and loosen the pinion and pinion collar. Tighten the setscrews and replace the knob.

Continue adjusting the pinion and pinion collar until the knob turns freely with a minimum of wobble.

The main dial should not move when the BFO control is rotated. If it does, tighten the pinion and pinion collar as described above.

The Vernier Tuning Knob assembled and installed on a 75A-4 Receiver is shown in figure 1.

Use the same procedure for installing the Vernier Tuning Knob on a Collins Type KWS-1 Transmitter. For other types of equipment, refer to figure 6 for mounting dimensions and drilling information.

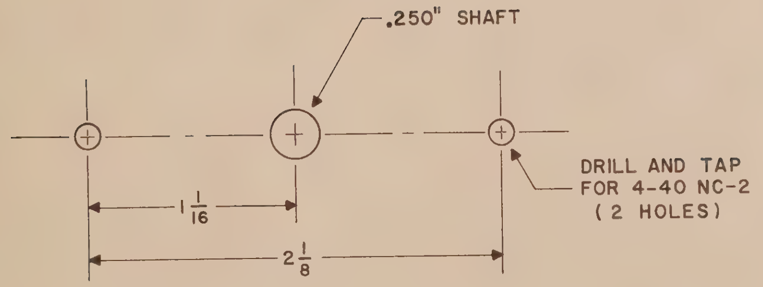
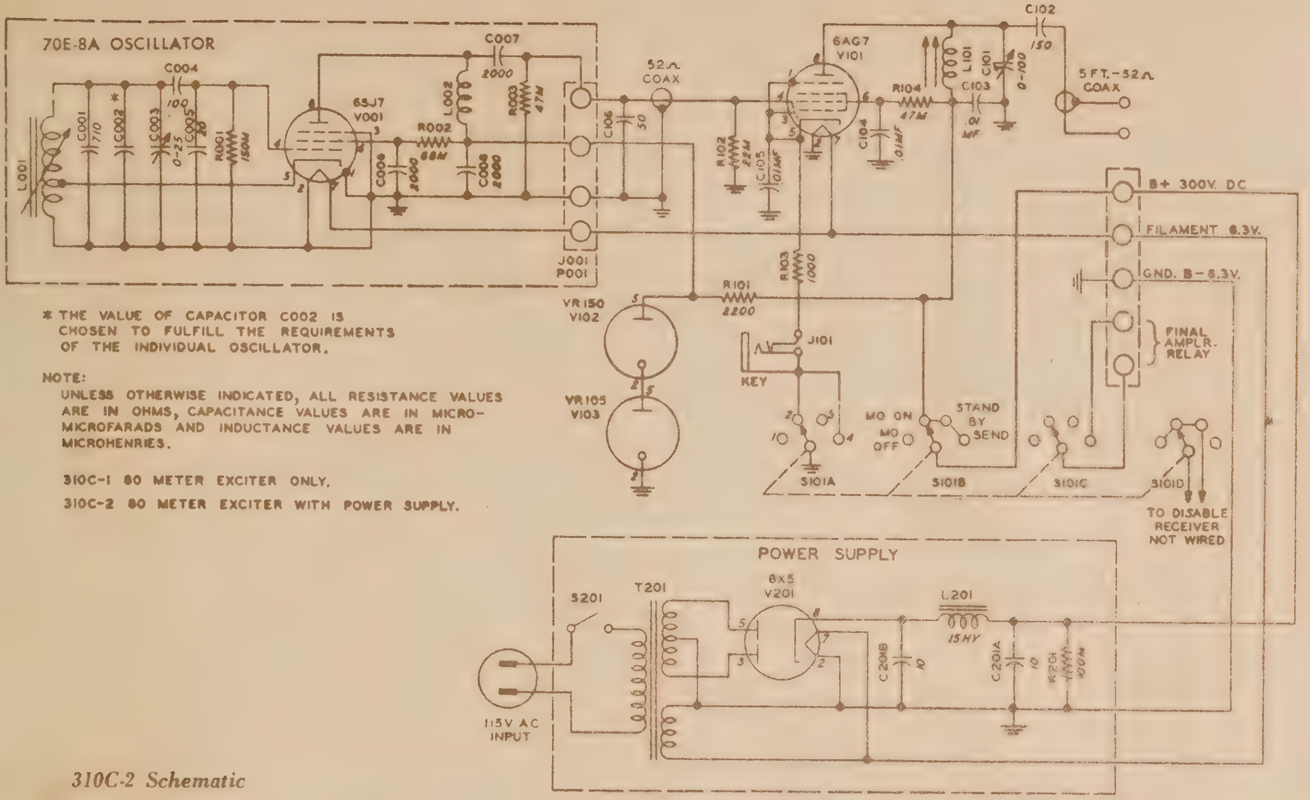


Figure 6. Mounting Dimensions and Drilling Template

COLLINS RADIO COMPANY
Cedar Rapids, Iowa

261 Madison Avenue, NEW YORK 16
1930 Hi-Line Drive, DALLAS 2
2700 W. Olive Avenue, BURBANK
Dogwood Road, Fountain City, KNOXVILLE
4471 N. W. 36th MIAMI 48

COLLINS RADIO COMPANY OF CANADA, LTD.
77 METCALFE ST., OTTAWA, ONTARIO



310C-2 Schematic

THE 310C-2

PROVIDES BASIC REQUIREMENTS

The 310C-2 is similar to the 310C-1. The only difference is that it has a self-contained power supply. In this unit you get a highly accurate and stable variable frequency control that is useful in many applications. Add professional performance to your rig by plugging the output of the 310C-2 into the crystal socket.

You'll find it a versatile instrument for test purposes, too. The accuracy and dependability suggest using it for aligning receiver amateur bands, and in heterodyne frequency meters.

CALIBRATION

An adjustable index on the vernier tuning dial can be set from the front panel for extreme accuracy. Utilizing the 6.4 mc - 8.0 mc scale, one division on the vernier dial represents one kilocycle. To check the accuracy of the oscillator, use the following table which gives the dial setting, oscillator harmonic, and the WWV time signal against which the oscillator is to be checked:

WWV (mc)	*Osc. Har.*	*Dial Setting*
15	8	7.500
15	9	6.666
10	5	8.000
10	6	6.666
5	3	6.666

TUBES

1—6SJ7	Oscillator
1—6AG7	Multiplier
1—6X5	Rectifier
1—VR105	Regulator
1—VR150	Regulator

POWER SOURCE: 115 v. a-c ±10%.

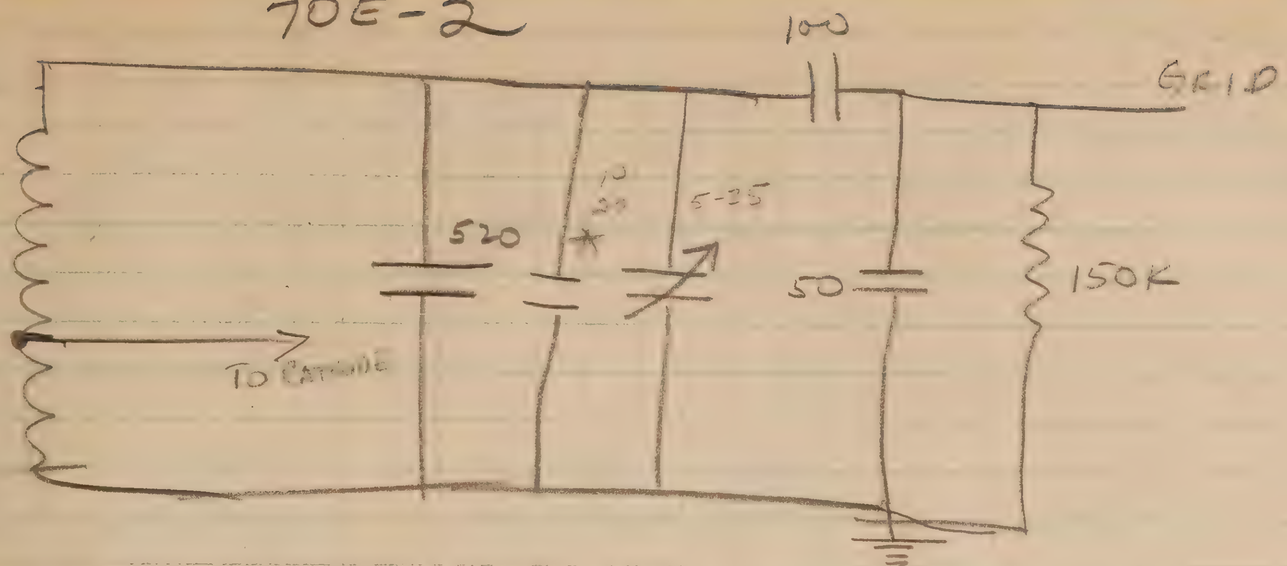
DIMENSIONS: 15 3/16" w, 8 3/8" d, 8 3/4" h.

WEIGHT: 18 pounds net.

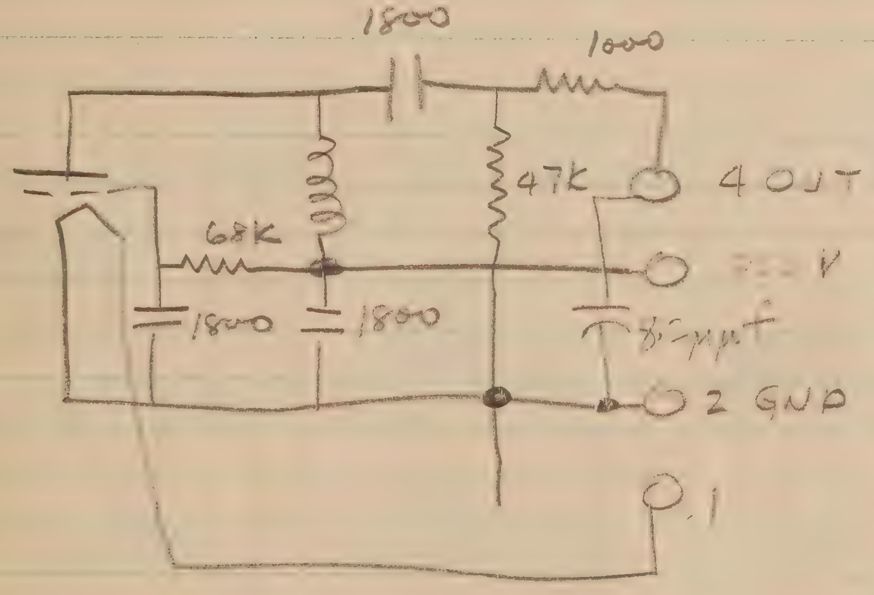
NET DOMESTIC PRICE, complete with tubes and instruction book:

310C-2 Exciter, with power supply........$100.00
Exclusive of any state or local taxes.

70E-2



* SELECTED TO MEET REQ. OF [illegible] OSC.



TUNING RANGE 2.0 — 3.0 MC   MODIFY TO 3.0 - 4.0

3.0 - 3.7

SCHEMATIC:

S 0936 00

ORIGINAL. "C" TRIMMER

NEW COMPUTATIONS ON VFO

$C_{ORIG} = 650 \mu\mu f$

@ 1.0 TURN f = 2.022 @ 11.0 Turn f = 3.024

$$L_{1.0} = \frac{1}{(6.28)^2 (f)^2 (C)} = \frac{1}{(6.28)^2 (2.022)^2\, 650} = 9.54 \mu hy$$

$$L_{11.0} = \frac{1}{(6.28)^2 f^2 C} = \frac{39.1}{f^2} \mu hy = \frac{39.1}{(3.024)^2} = 4.26 \mu hy$$

DESIRED TO MOVE TO 3.045 TO 4.045

$C = 500 \mu\mu f$

$$L_{1.0} = \frac{1}{(6.28)^2 f^2\, 500} = \frac{50.8}{f^2} \mu hy = \frac{50.8}{(3.045)^2} \quad 5.47 \mu hy$$

$$L_{11.0} = \frac{1}{(6.28)^2 f^2\, 500} = \frac{50.8}{(4.045)^2} \mu hy = 3.11 \mu hy$$

Correct value of parallel inductor

$$L = \frac{(9.54)(5.47)}{9.54-5.47} = \frac{(9.54)(5.47)}{4.07} = 14.1 \mu hy$$

1620 ① 300 ÷

$$\begin{array}{r} 1 \\ \text{[illegible]} \\ \underline{\text{[illegible]}} \\ 1320 \\ 300 \\ \boxed{1620} \end{array} \qquad \begin{array}{r} 2 \\ 240 \\ \underline{6} \\ 1440 \\ \underline{32} \\ \boxed{1720} \end{array}$$

$C_{OSC} = 650\ \mu\mu f$

$L @ 1.0\ Mc = 9.54\ \mu hy$

$L @ 11.0 = \underline{4.26}$

$\Delta L = 5.28$ for $\Delta f = 1.0\ Mc$ from 2024 to

C new $= \underline{\underline{390}}\ \mu\mu f$

3,043 Mc RESONANT POINT OF TRAP

$$L = \frac{1}{(6.28)^2 (3.043)^2\, 390} = 7.0\ \mu hy$$

PARALLEL INDUCTOR

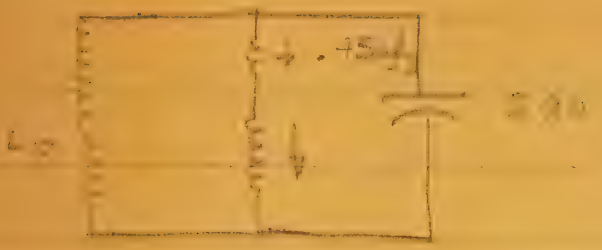
$$L_{1.0} = \frac{(9.54)(7.0)}{2.54} = \underline{26.3\ \mu hy}$$

$$L_{11.0} = \frac{(26.3)(4.3)}{30.6} = 3.7\ \mu hy$$

$$f @_{11.0} = \frac{10^9}{2\pi\sqrt{(3.7)(390)}} = \frac{159\times10^6}{\sqrt{1440}} = \frac{159}{38}\times10^6$$

$f_{@11.0} = 4,180.0$ $\qquad \Delta f = 1,180$ Kc per [illegible]

IF USE



L @ 1 turn = 10.0 μhy   L @ 11 turn = 4.70 μhy

Ls = .45 μhy

Needed to resonate with 330 μμf   L = 7.0 μhy

$$L_p = \frac{(10)(7)}{3} = \frac{70}{3} = 23.3\ \mu hy$$

@ 11 turns $L = \frac{(23.3)(4.70)}{28} = 3.91\ \mu hy$

$$f = \frac{159 \times 10^6}{\sqrt{(3.9)(331)}} = \frac{159 \times 10^6}{\sqrt{1575}} = 4{,}070\ Mc$$

Δf = 1.070 Mc For 10 Turns ←

USE L_s = .60 μhy

L @ 1 turn = 10.15 μhy   L @ 11 turn = 4.85 μhy

$$L_p = \frac{(10.15)(7.00)}{3.15} = 22.5\ \mu hy$$

@ 11 turns $L = \frac{(22.5)(4.85)}{27.35} = 4.00$

$$f = \frac{159}{\sqrt{(4.0)(330)}} \times 10^6 = \frac{159}{\sqrt{1565}} \times 10^6 = 3{,}960$$ ←

Δf = 3.960 − 3.045 = .915 Mc

C_T 370 + 50 = 420

$$L_{1.0T} = \frac{1}{(6.28)^2(3.045)^2(420)} = \underline{6.5\ \mu hy}$$

USE L_s = .45 μhy

$$L_p = \frac{(6.5)(10.00)}{3.5} = 18.6\ \mu hy$$

IF C_T = 430 μμf & L_s = .45 μhy

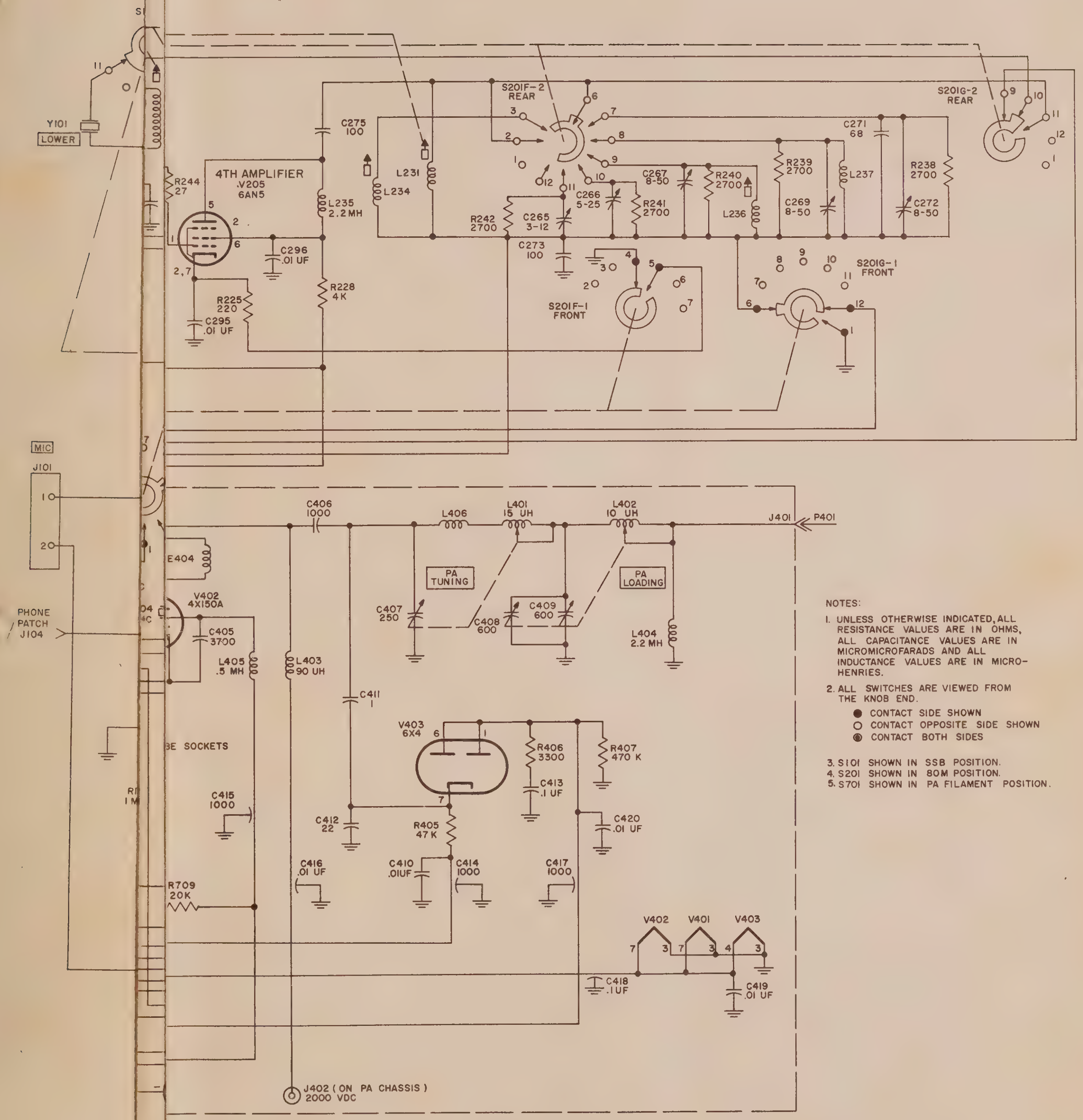
$$L_{1.0T} = 6.5\left(\frac{420}{430}\right) = 6.35\ \mu hy$$

$$L_p = \frac{(6.35)(10.00)}{3.65} = \frac{63.5}{3.65} = 17.4\ \mu hy$$

@ 11.0 turns $$L_{11.0} = \frac{(17.4)(4.70)}{22.1} = 3.70$$

$$f = \frac{159}{\sqrt{3.70(430)}}\times 10^6 = \frac{159}{\sqrt{1590}}\times 10^6 = \frac{159}{39.9}\times 10^6 = 4.000\ Mc$$

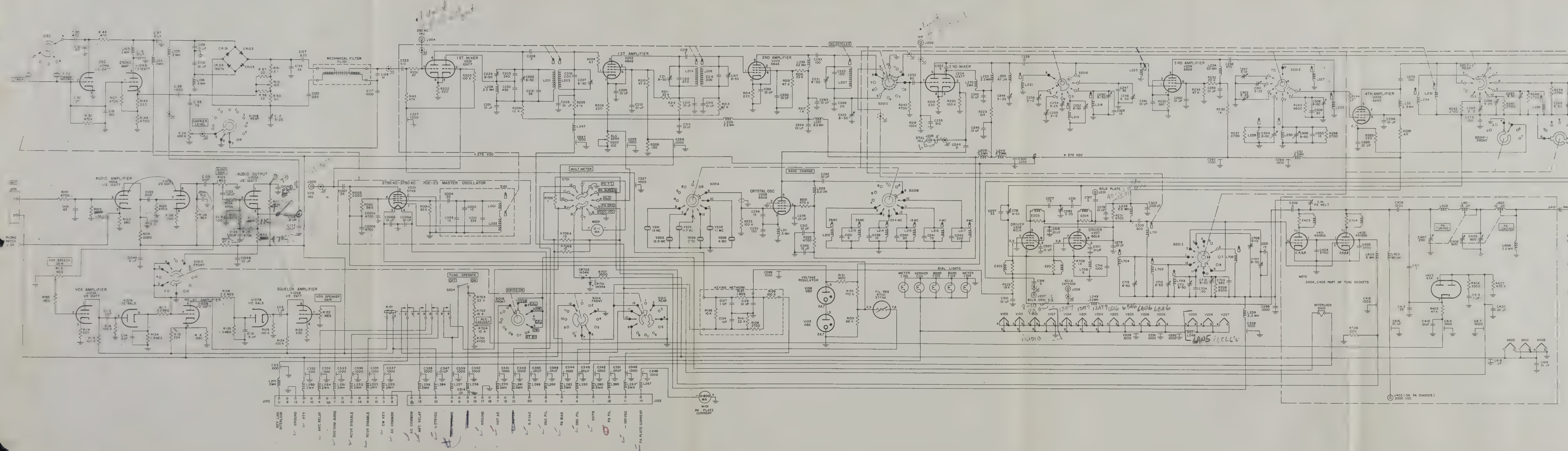
Δf = 4.000 − 3.045 = .955 Mc IN 10 turns



NOTES:

1. UNLESS OTHERWISE INDICATED, ALL RESISTANCE VALUES ARE IN OHMS, ALL CAPACITANCE VALUES ARE IN MICROMICROFARADS AND ALL INDUCTANCE VALUES ARE IN MICROHENRIES.
2. ALL SWITCHES ARE VIEWED FROM THE KNOB END.
   - ● CONTACT SIDE SHOWN
   - ○ CONTACT OPPOSITE SIDE SHOWN
   - ◉ CONTACT BOTH SIDES
3. S101 SHOWN IN SSB POSITION.
4. S201 SHOWN IN 80M POSITION.
5. S701 SHOWN IN PA FILAMENT POSITION.

Figure 7-1. Exciter/Power Amplifier, Complete Schematic Diagram



NOTES

1. UNLESS OTHERWISE INDICATED, ALL RESISTANCE VALUES ARE IN OHMS, ALL CAPACTANCE VALUES ARE IN MICROMICROFARADS AND ALL INDUCTANCE VALUES ARE IN MICRO-HENRIES
2. ALL SWITCHES ARE VIEWED FROM THE KNOB END
   - ● CONTACT SIDE SHOWN
   - ○ CONTACT OPPOSITE SIDE SHOWN
   - ● CONTACT BOTH SIDES
3. S101 SHOWN IN SSB POSITION
4. S20 SHOWN IN 80M POSITION
5. S701 SHOWN IN PA FILAMENT POSITION

Figure 7-1. Exciter/Power Amplifier, Complete Schematic Diagram

Rebekah [illegible]

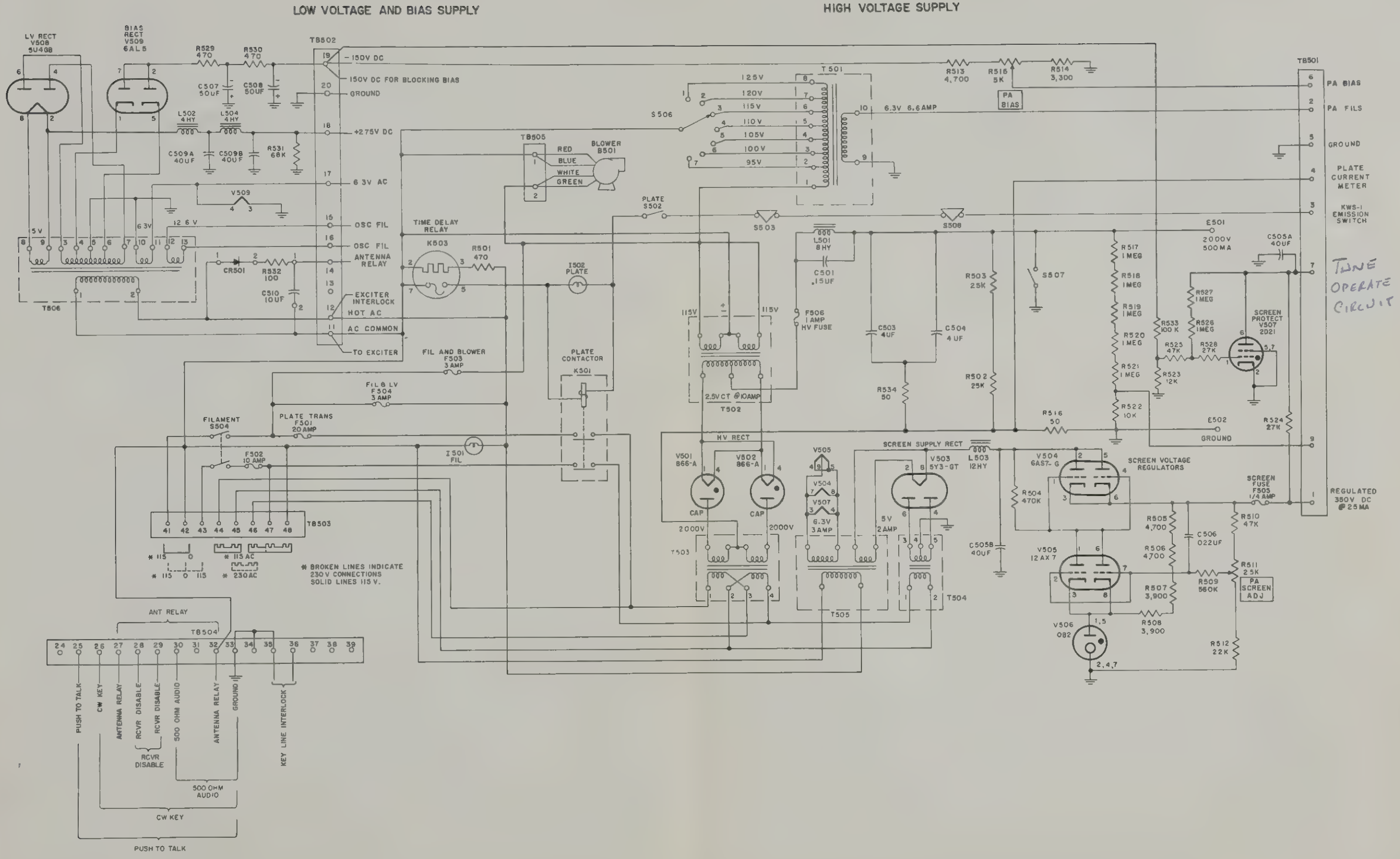


Figure 7-2. Power Supply, Complete Schematic Diagram

F455B-31
596 2924 002 $12.52 25 Obsolete Stock

F455B-31
526 9042 00 150 μμf 10DB Loss. $11.66 45 Stock

F455E-31
526 9074 00 150 μμf 10DB Loss

Type F Mounting

F455D-31
526 9056 002 150 μμf 10DB Loss

F455F-31
526 9075 00 150 μμf 10DB Loss

Globe-Wernicke
CINCINNATI

TO RE-ORDER SPECIFY
No. K 621½ FOLDER
MADE IN U. S. A.

461

Scheduled
~~Scheduled~~ Dropping Lead

Released to production

APPLICATION BULLETIN

EITEL-McCULLOUGH, INC.

SAN BRUNO, CALIFORNIA

NUMBER 5

TUBE PERFORMANCE COMPUTOR

DETAILED INSTRUCTIONS

TUBE PERFORMANCE COMPUTOR FOR RF AMPLIFIERS (CLASS B, C, AND FREQUENCY MULTIPLIERS)

It is quite easy to make a close estimate of the performance of a vacuum tube in radio frequency power amplifier service, or an approximation in the case of harmonic amplifier service. Such estimates will give RF output power, DC input power, grid driving power and all DC current values.

These estimates can be made easily by using the Eimac Tube Performance Computor and the characteristic curves of a tube, plotted on plate voltage/grid voltage curves (constant current curves). Only the ability to multiply out figures taken from the curves by means of the computor is required.

By graphically laying out the trace of the plate and grid voltages as they rise and fall about the applied DC plate voltage and DC grid bias a clearer understanding is possible of the action taking place within a tube. With such an understanding the operating conditions can be altered readily to suit one's particular requirements.

Simple Action in Class C RF Amplifiers

In an amplifier a varying voltage is applied to the control grid of the tube. Simultaneously the plate voltage will vary in a similar manner, due to the action of the amplified current flowing in the plate circuit. In radio frequency applications with resonant circuits these voltage variations are smooth sine wave variations, 180° out of phase (as the grid voltage rises and becomes *more* positive, the plate voltage falls and becomes *less* positive) as indicated in Fig. 1. Note how these variations center about the DC plate voltage and the DC control grid bias.

Let us now see how such variations of the plate and grid voltages of a tube appear on the constant current curve sheet of a tube. In Fig. 2 these variations have been indicated next to the plate voltage and grid voltage scales of a typical constant current curve. At some instant of time, shown as "t" on the time scales, the grid voltage has a value which is the point marked "eg" on the grid voltage sine wave. At this same instant of time the plate voltage has a value which is the point "ep" marked on the plate voltage sine wave. If now one finds the point on the tube curve sheet corresponding to these values (where a line drawn from "eg" and a line drawn from "ep" cross) he will be at point A in Fig. 2. As the values of grid voltage "eg" and plate voltage "ep" vary over the RF cycle, the point A moves up and down a line, which in the case of the normal RF power amplifier is a straight line. This line is called the "Operating Line."

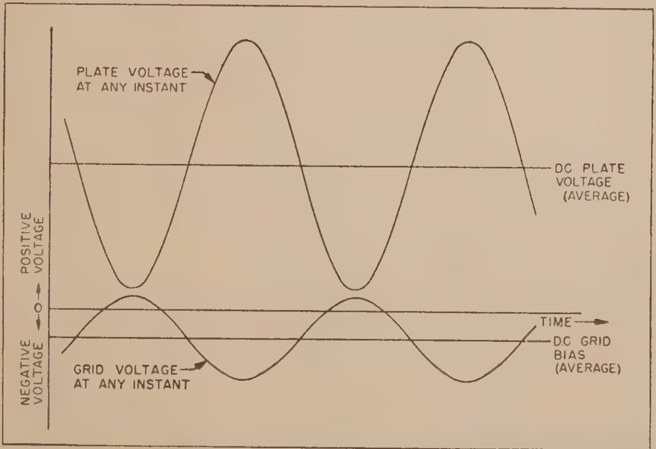


PLATE VOLTAGE AT ANY INSTANT
DC PLATE VOLTAGE (AVERAGE)
POSITIVE VOLTAGE
0
NEGATIVE VOLTAGE
TIME
DC GRID BIAS (AVERAGE)
GRID VOLTAGE AT ANY INSTANT

Figure 1

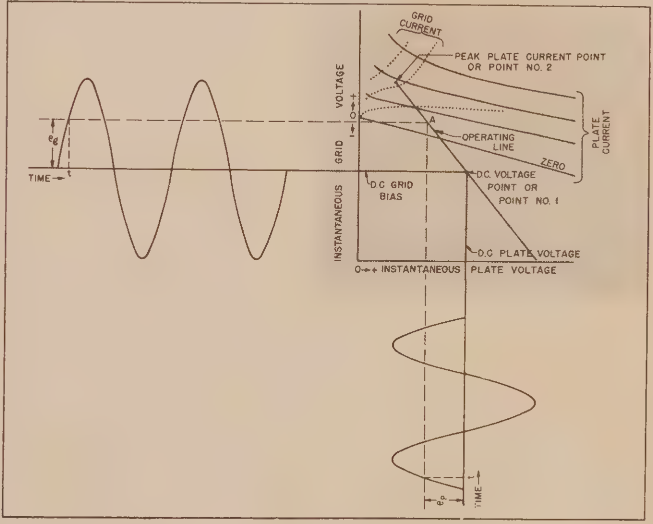

GRID CURRENT
PEAK PLATE CURRENT POINT OR POINT NO. 2
INSTANTANEOUS GRID VOLTAGE
+
0
−
e_g
TIME
t
A
OPERATING LINE
ZERO
PLATE CURRENT
D.C GRID BIAS
D.C. VOLTAGE POINT OR POINT NO. 1
D.C PLATE VOLTAGE
0 + INSTANTANEOUS PLATE VOLTAGE
e_p
t
TIME

Figure 2

Any point on the operating line (when drawn on a curve sheet as in Fig. 2 or Fig. 4) tells the instantaneous values of plate current, screen current, and grid current which must flow when those particular values of grid and plate voltage are applied to the tube. Thus by reading off the values of the currents and plotting them against the time, t, one can obtain a curve of instantaneous values of plate and grid current. See Fig. 3.

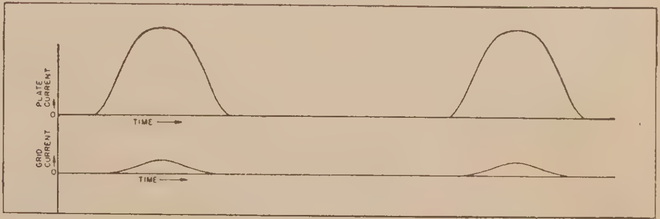


Figure 3

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If we analyze the plate and grid current values shown, we can predict that they will cause a DC ammeter to show a particular reading. This is called the DC component of the current. Also, we can predict that if the plate current flows through a properly loaded resonant RF circuit a certain amount of radio frequency power will be delivered to that circuit. If the circuit is tuned to the fundamental frequency (same frequency as the RF grid voltage) the power delivered will be due to the fundamental (or principle radio frequency) component of plate current. If the circuit is tuned to a harmonic of the grid voltage frequency (for instance, two, or three times the frequency) the power delivered will be due to a harmonic component of the plate current.

The Eimac Tube Performance Computor gives us the means to make these simple calculations. It is a means with which to determine the DC component, the fundamental RF component, or the approximate harmonic component of the current flowing in a tube when the tube is operating as a radio frequency amplifier, and enables one to state what all meter readings will be and to predict the RF output power and the required driving power. With these factors known we are then able also to forecast what will happen if any of the operating conditions are changed.

Use of the Eimac Tube Performance Computor

The Eimac Tube Performance Computor is a simple aid to enable one to select suitable values from the characteristic curves of a tube, and by means of simple calculations to forecast the performance of the tube in radio frequency power amplifiers.

The basic steps are outlined under "Instructions" on the computor. This requires selecting DC plate and grid bias voltages, being guided by the typical operating values given on the technical data sheet for the tube type and by general experience. Next, a suitable "Operating Line" must be chosen on the constant current curves for the tube type (plotted on grid voltage/plate voltage scales).

The computor when properly placed over this operating line enables one to obtain instantaneous values of the currents flowing at every 15° of the electrical cycle. The formulas given on the computor were derived by Chaffee[1] to give the various average and harmonic components of the resulting currents. Knowing these current component values and the radio frequency voltage values which are indicated by the use of the computor, one can readily calculate the complete performance of the tube.

The fundamental methods of making such computations, and the considerations necessary to stay within ratings of the tube types, and accomplish various forms of modulation have been covered in the literature.[2,3,4,5,6,7] The method for the case of harmonic amplifier service is approximate and should be used only for tetrode and pentode tubes, where the plate voltage has little effect on the amount of plate current flowing. A more exact method, showing that for harmonic operation the operating line is a simple Lissajou figure, has been described by Brown.[8]

The results of using this computor for power amplifier service can be applied in combination with the other methods given in the literature to give good accuracy with simpler procedues. The resulting accuracy is well within the normal variation of tube characteristics due to the normal variation in manufacturing dimensions of a tube. Since the published tube curves are only typical of the characteristics to be expected from a particular tube type, the calculated performance is well within the values expected when different tubes of a given tube type are operated under the assumed conditions.

Example Showing Detailed Use of the Eimac Tube Performance Computor

Radio Frequency Power Amplifier, Class C (Telegraphy or FM)

Let us say we have an Eimac 4-65A tetrode and want to make it work effectively. Also let us say we have a 2000 volt DC plate power supply available.

Within frequency limits, we know a tube should be able to run in class-C amplifier service with about 75% efficiency, or, in other words, to convert 75% of the DC plate input power into RF output power. The difference, or 25% of the input power, is dissipated or lost as heat on the plate of the tube. The DC plate input power is then about four times the power dissipated on the plate.

The 4-65A tetrode has a maximum rated plate dissipation of 65 watts, so, to illustrate performance near the maximum rating, we'll choose an input power four times the plate dissipation, or 260 watts per tube. At 2000 volts the plate current per tube must then be 130 ma. It is usual practice, in the case of tetrodes and the medium or low mu triodes in class-C amplifier service for the DC grid bias voltage to be roughly two or three times the grid voltage necessary to cut off the flow of plate current. By referring to the curves of the 4-65A we decide to use a DC grid bias voltage of–120 volts.

Let us now locate the "Operating Line" on the constant current curves of the 4-65A. See Fig. 4. First mark the point where the DC grid bias and DC plate voltage cross. The "Operating Line" must go through this point. Call it point No. 1. Next, we must decide what the peak value of plate current of the tube must be and how low we can let the instantaneous value of plate voltage go when the tube is passing this much current. This is necessary in order to locate the other end of the "Operating Line," point No. 2.

The peak value of plate current usually runs about four times the DC plate current. The minimum value of instantaneous plate voltage is usually set by the fact that if the voltage is too low the grid and screen currents will be needlessly high, and also little will be gained as far as output power is concerned. The minimum value of plate voltage is usually in the region where the plate constant current curves bend upward. See Fig.

4. (In the case of the triode this is near the "diode line" or line where the instantaneous grid and plate voltages are equal.) The practical procedure in calculating tube performance is to arbitrarily choose point No. 2 and complete the calculations. Then try other locations of point No. 2, complete the calculations, and compare the results.

In the case of the 4-65A let us choose a peak value of plate current about four times the DC plate current of 130 ma, or 500 ma. Let us choose a minimum instantaneous plate voltage of 250 volts and thus fix the upper end of the "Operating Line." Next, locate this point on the tube curves. This is point No. 2 on Fig. 4. (The plate currents which flow at various combinations of plate and grid voltages are shown by the plate current lines. The value of current for each line is noted. In-between values can be estimated closely enough for our purposes.) Now draw a straight line between points No. 1 and No. 2. This line is the "Operating Line" and shows the current and voltage values for each part of the RF cycle when current is being taken from the tube. (The non-conducting half of the RF cycle would be shown by extending this line an equal distance on the opposite side of point No. 1. However, there is little use in so doing because no current flows during this half of the cycle.)

The Eimac Tube Performance Computor can now be used to obtain the meter readings and power values from this "Operating Line." Place the computor on the constant current curve sheet so that the "guide lines" of the computor are parallel with the operating line. Now slide the computor about without turning it until the line OG passes through the DC voltage point No. 1 and line OA passes through the peak current point No. 2. *Make sure the guide lines are still parallel to the "Operating Line."*

Note that the lines OB, OC, OD, OE and OF of the computor all cross over the "Operating Line."

At each point where the lines OA, OB, etc., cross the "Operating Line" we need to determine the instantaneous values of plate current and grid current (and screen current if a tetrode or pentode is used) which is flowing at that particular moment in the RF cycle. Later, from these key values of current, we will calculate the values of DC plate current and grid current (and screen current) as well as the RF components of the plate current.

At each of these points, where the instantaneous current values are to be determined, a mark should be made on the constant current curve sheet of the tube. By noting where this mark lies with respect to the plate current curves, one can estimate the value of plate current flowing at this part of the cycle. Next, the location of this mark with respect to the control grid curves is noted and a value of grid current is estimated. Finally, by referring the mark to the screen grid curves, if the tube is a tetrode or pentode, a value of screen current is noted. These current values should be listed for each

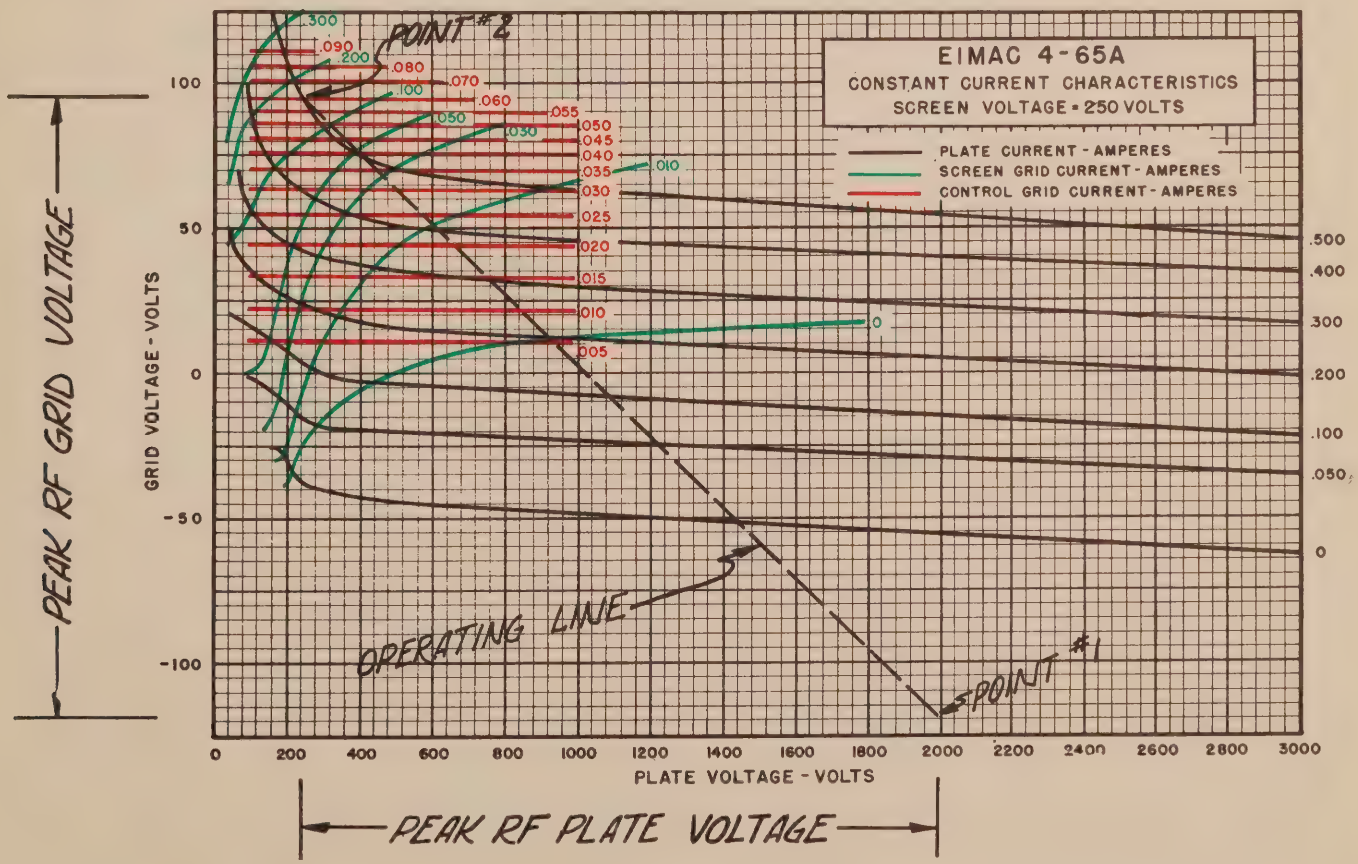

Figure 4

point where the lines OA, OB, etc., cross the operating line so that they can be combined later to calculate the various tube currents. At points where OF and OE cross, the current values are often zero.

Now in the example chosen, let us read off the instantaneous plate current values where these lines cross the "Operating Line." At the point where the line OA crosses the "Operating Line" the plate current is 500 ma. Where OB crosses the operating line the plate current can be estimated as 510 ma since the point is about 1/10 of the way from the 500 ma line to the 600 ma line. At OC the plate current is 460 ma, OD 290 ma, OE 75 ma, OF and OG 0 ma. Similarly we can estimate the instantaneous screen current at the crossing of OA and the "Operating Line" as 165 ma, and the instantaneous grid current at 60 ma. Values are read for the other crossings and written down. These values are put in simple columns for calculating:

Crossing of line	Simplified Name in Formulas	Instantaneous Values of Currents		
		Plate	Screen	Control Grid
OA	A	500 Ma	165 Ma	60 Ma
OB	B	510	100	50
OC	C	460	25	30
OD	D	290	5	14
OE	E	80	0	0
OF	F	0	0	0

Now in order to obtain the DC value of plate, screen, and control grid currents the formula (see computor) says to add up the above values but use only one-half of the A values (giving 250 ma for plate, 82 ma for screen, and 30 ma for grid), and then divide by 12, as follows:

DC Meter Reading = 1/12 (0.5 A+B+C+D+E+F)

Plate	Screen	Control Grid
250 Ma	82 Ma	30 Ma
510	100	50
460	25	30
290	5	14
80		
Total 1590 Ma	212 Ma	124 Ma
DC Current = 1/12 Total = 132 Ma	18 Ma	10 Ma

Now to calculate the RF output power it is necessary to use the formula for the peak RF current which is present in the tube plate current. Since we are using the tube as a straight RF power amplifier we use the formula for "Peak Fundamental RF" as shown on the computor. (If we were estimating the performance of a doubler or tripler we would use the formula for "Peak 2nd Harmonic RF" or "Peak 3rd Harmonic RF".)

From the computor we see that the formula for the peak fundamental RF current is:

1/12 (A+1.93 B+1.73 C+1.41 D+E+0.52 F)
A = 500 = 500 Ma
1.93 B = 1.93x 510 = 985
1.73 C = 1.73x 460 = 796
1.41 D = 1.41x 290 = 409
E = 80 = 80
Total = 2770 Ma
Peak fundamental current = 1/12 Total
= 2770/12 = 230 Ma

We now have the various current values. In order to calculate the powers involved it is necessary to know, not only the DC voltage values, but the greatest amount each voltage swings away from the DC value. This is known as the peak value of the RF voltage. Because the plate voltage swings from 2000 volts down to 250 volts the peak RF voltage is the difference, or 1750 volts. Similarly the grid voltage must rise and fall between the operating points No. 1 and No. 2, or from −125 volts to +95 volts. This is a peak swing of 220 volts and the peak RF grid voltage is 220 volts.

Let us now use the formulas for output power and driving power:

Output power = ½ peak RF plate current x peak RF plate voltage.

We found the peak RF plate current to be 230 ma or .230 amperes, and the peak RF plate voltage to be 1750 volts.

So; Output Power = ½ x .230 x 1750 = 201 watts,
and Input Power = DC Plate Current x DC Plate Voltage
= .132 x 2000 = 264 watts
Plate Dissipation = DC Input Power—RF Output Power
= 264 − 201 = 63 watts
Efficiency = RF Output Power divided by DC Input Power
= 201/264 = 76%
Driving Power = DC Grid Current x Peak RF Grid Voltage
So the Driving Power = .010 x 220 = 2.2 watts

The power consumed by the bias source is simply the product of the DC grid current and the DC grid voltage, or .010 x 120 = 1.2 watts.

The difference between the driving power and the power consumed by the bias source is the power dissipated on the control grid, or 2.2 − 1.2 = 1.0 watts.

The power dissipated on the screen grid is simply the product of the DC screen current and the DC screen voltage, because the screen grid has no impedance between it and the DC screen supply. Thus it is .018 x 250 = 4.5 watts.

The performance of the tube can now be summarized:

DC Plate Voltage	2000 Volts	Driving Power	2.2 Watts
DC Screen Voltage	250 Volts	Grid Dissipation	1.0 Watts
DC Grid Voltage	—120 Volts	Screen Dissipation	4.5 Watts
DC Plate Current	132 Ma	Plate Power Input	264 Watts
DC Screen Current	18 Ma	Plate Power Output	201 Watts
DC Grid Current	10 Ma	Plate Dissipation	63 Watts
Peak RF Grid Voltage	220 Volts		

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2. H. P. Thomas, "Determination of Grid Driving Power in Radio Frequency Power Amplifiers," Proc. IRE, Vol. 21, pp. 1134-1141; August 1933
3. W. G. Wagener, "Simplified Methods for Computing Performance of Transmitting Tubes," Proc. IRE; January 1937
4. R. I. Sarbacher, "Graphical Determination of PA Performance," Electronics; December 1942
5. R. I. Sarbacher, "Performance of Self Biased Modulated Amplifier," Electronics; April 1943
6. "Class C Amplifier Calculations With The Aid of Constant-Current Characteristics," Eimac Application Bulletin Number 4
7. "Vacuum Tube Ratings," Eimac Application Bulletin Number 6
8. Robert H. Brown, "Harmonic Amplifier Design," Proc. IRE, Vol. 35 pp. 771-777; August 1947

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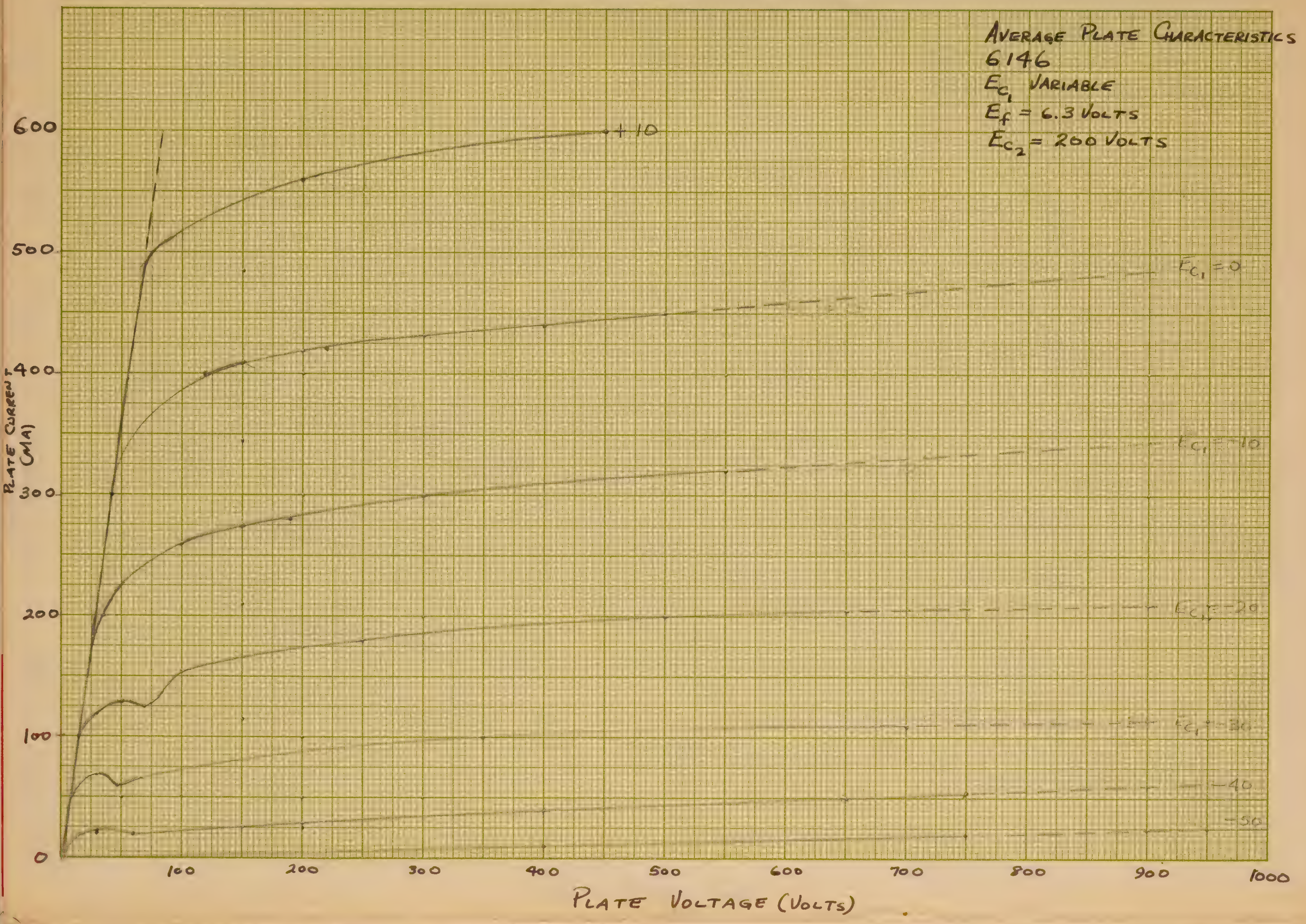
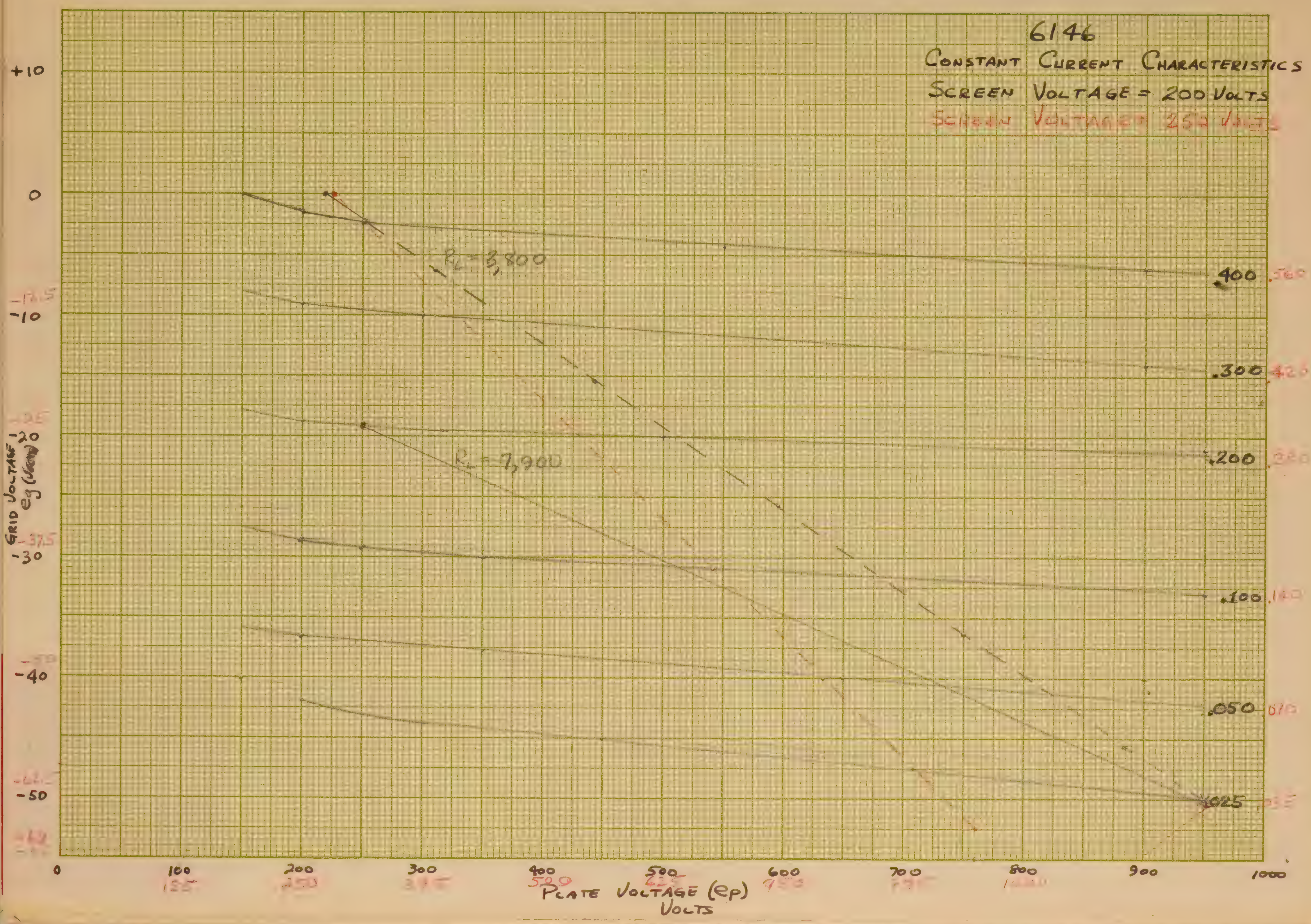


AVERAGE PLATE CHARACTERISTICS
6146
E_{c_1} VARIABLE
E_f = 6.3 VOLTS
E_{c_2} = 200 VOLTS

K+E KEUFFEL & ESSER CO. MADE IN U.S.A.

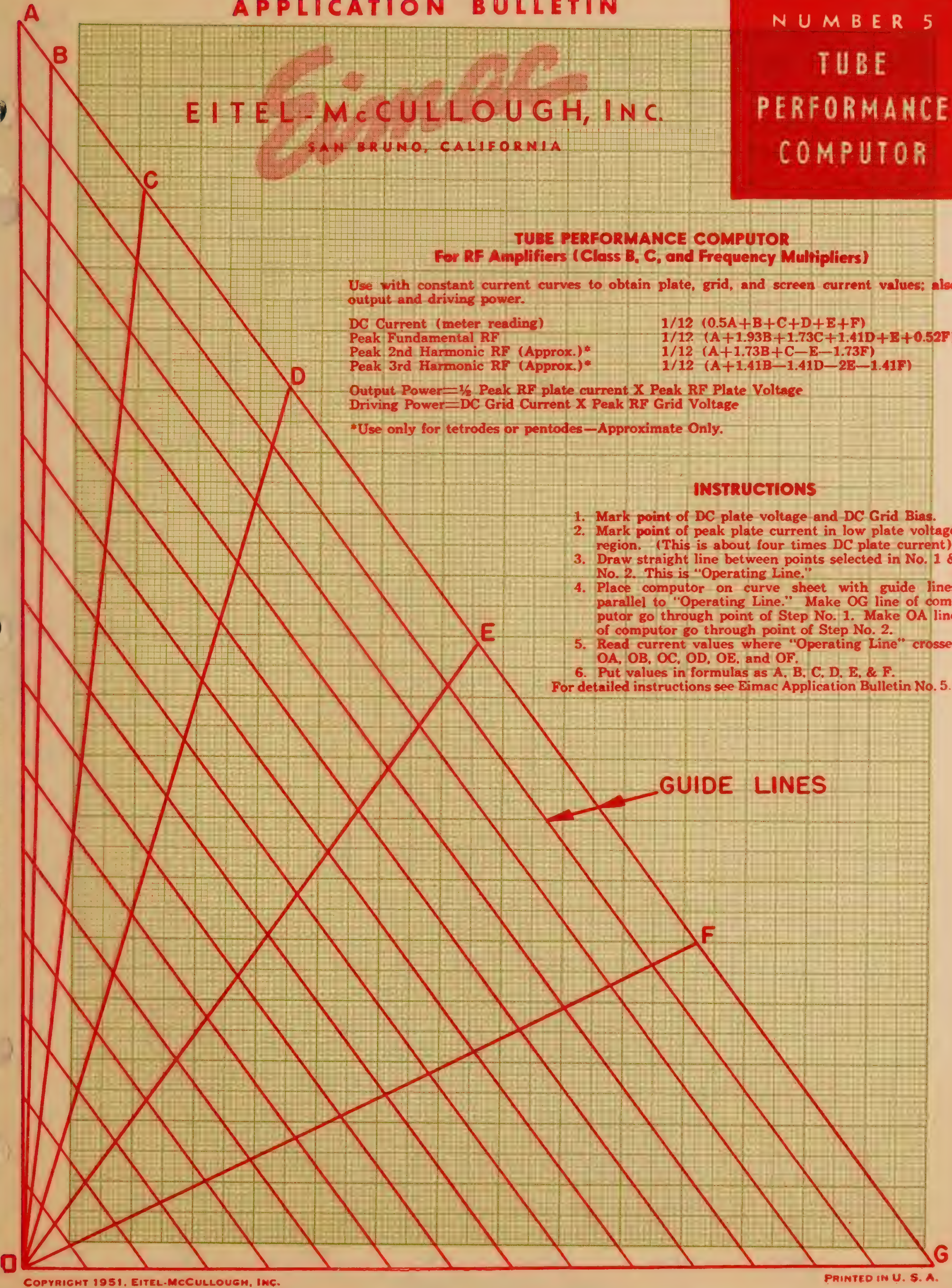


APPLICATION BULLETIN

Eimac
EITEL-McCULLOUGH, INC.
SAN BRUNO, CALIFORNIA

NUMBER 5

TUBE PERFORMANCE COMPUTOR



TUBE PERFORMANCE COMPUTOR
For RF Amplifiers (Class B, C, and Frequency Multipliers)

Use with constant current curves to obtain plate, grid, and screen current values; also output and driving power.

DC Current (meter reading)	1/12 (0.5A+B+C+D+E+F)
Peak Fundamental RF	1/12 (A+1.93B+1.73C+1.41D+E+0.52F)
Peak 2nd Harmonic RF (Approx.)*	1/12 (A+1.73B+C—E—1.73F)
Peak 3rd Harmonic RF (Approx.)*	1/12 (A+1.41B—1.41D—2E—1.41F)

Output Power=½ Peak RF plate current X Peak RF Plate Voltage
Driving Power=DC Grid Current X Peak RF Grid Voltage

*Use only for tetrodes or pentodes—Approximate Only.

INSTRUCTIONS

1. Mark point of DC plate voltage and DC Grid Bias.
2. Mark point of peak plate current in low plate voltage region. (This is about four times DC plate current).
3. Draw straight line between points selected in No. 1 & No. 2. This is "Operating Line."
4. Place computor on curve sheet with guide lines parallel to "Operating Line." Make OG line of computor go through point of Step No. 1. Make OA line of computor go through point of Step No. 2.
5. Read current values where "Operating Line" crosses OA, OB, OC, OD, OE, and OF.
6. Put values in formulas as A, B, C, D, E, & F.

For detailed instructions see Eimac Application Bulletin No. 5.

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NUMBER 5
TUBE
PERFORMANCE
COMPUTOR

APPLICATION BULLETIN

EITEL-McCULLOUGH, INC.
SAN BRUNO, CALIFORNIA

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Use with constant current curves to obtain plate, grid, and screen current values; also output and driving power.

DC Current (meter reading)	1/12 (0.5A+B+C+D+E+F)
Peak Fundamental RF	1/12 (A+1.93B+1.73C+1.41D+E+0.52F)
Peak 2nd Harmonic RF (Approx.)*	1/12 (A+1.73B+C—E—1.73F)
Peak 3rd Harmonic RF (Approx.)*	1/12 (A+1.41B—1.41D—2E—1.41F)

Output Power=½ Peak RF plate current X Peak RF Plate Voltage
Driving Power=DC Grid Current X Peak RF Grid Voltage

*Use only for tetrodes or pentodes—Approximate Only.

INSTRUCTIONS

1. Mark point of DC plate voltage and DC Grid Bias.
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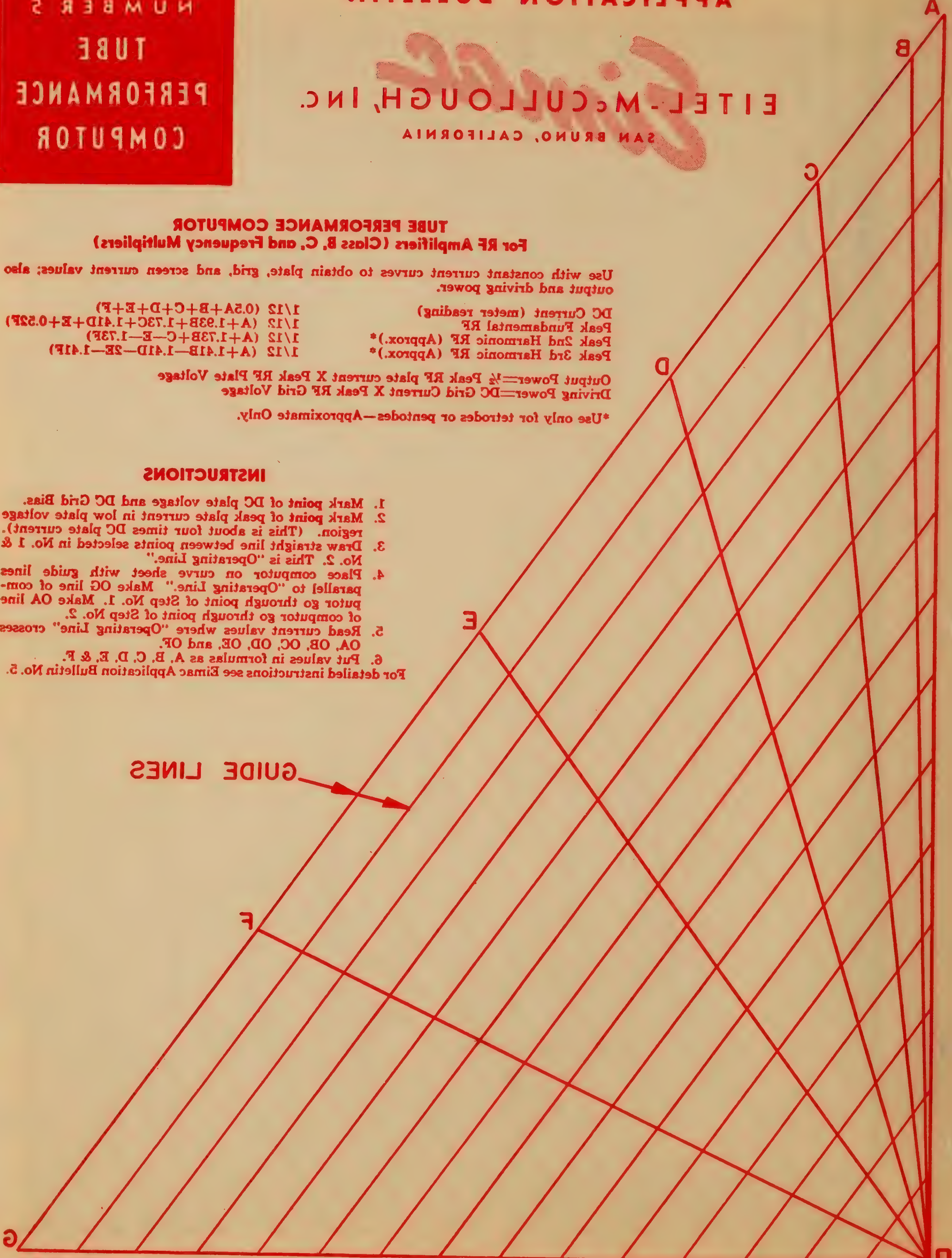
5. Read current values where "Operating Line" crosses OA, OB, OC, OD, OE, and OF.
6. Put values in formulas as A, B, C, D, E, & F.

For detailed instructions see Eimac Application Bulletin No. 5.



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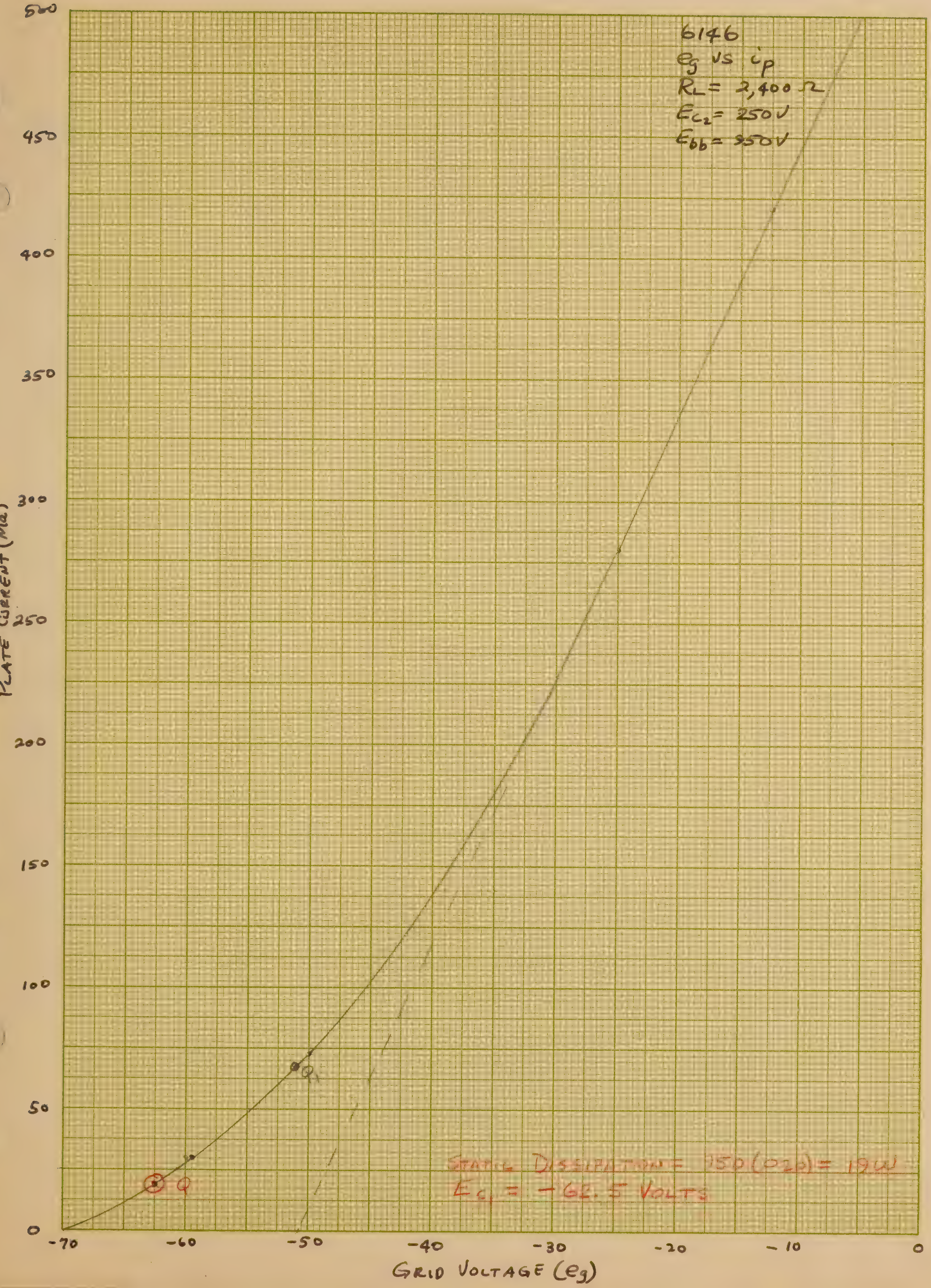
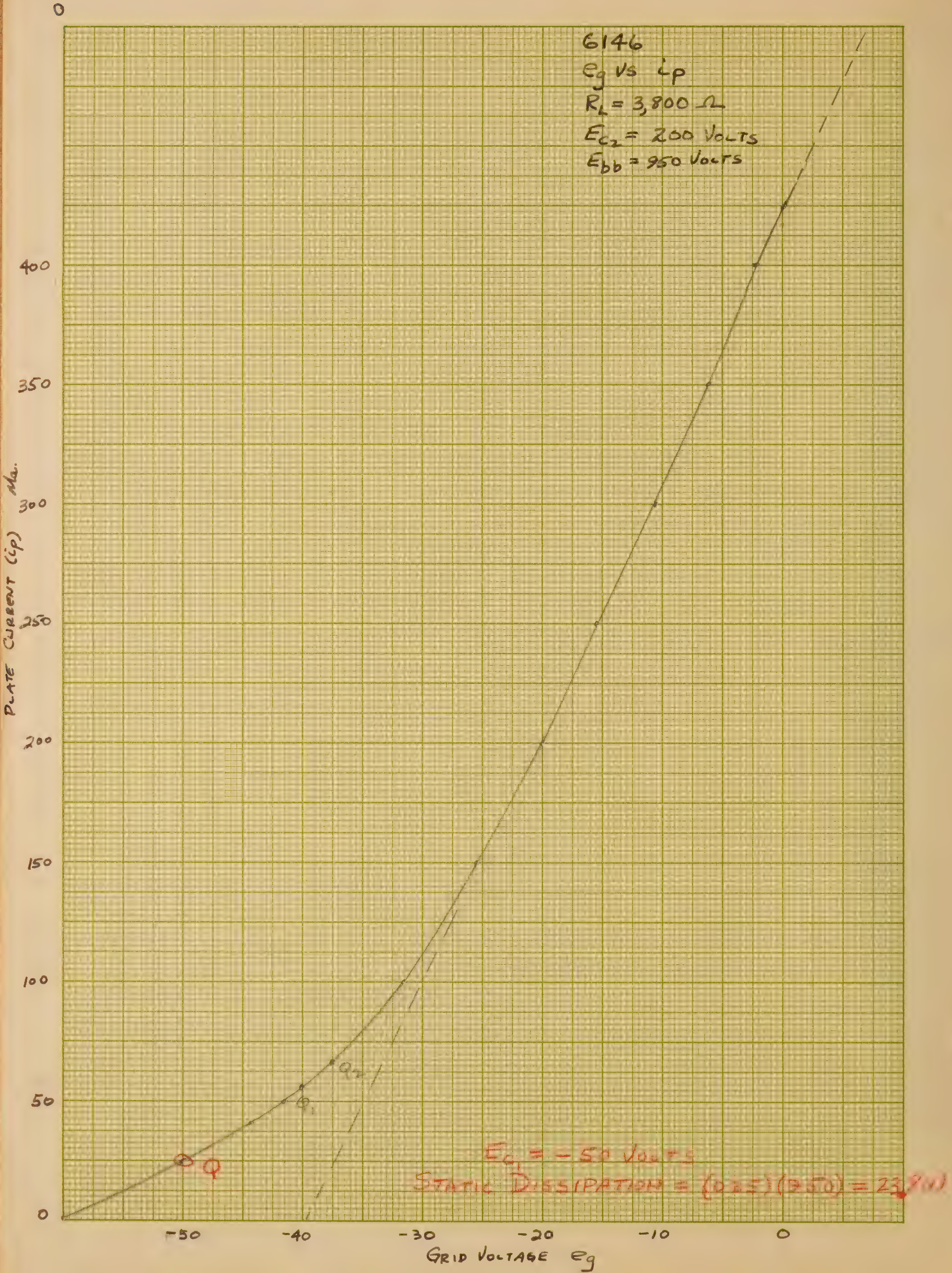


K+E 10 X 10 TO THE ½ INCH KEUFFEL & ESSER CO. 358-11 MADE IN U.S.A.



K&E 10 X 10 TO THE 1/2 INCH 359-11
KEUFFEL & ESSER CO. MADE IN U.S.A.

K+E 10 X 10 TO THE ½ INCH 358-11
KEUFFEL & ESSER CO. MADE IN U. S. A.

COMPUTATIONS FOR SCREEN VOLTAGE = 250 VOLTS
PLATE SUPPLY = 350 VOLTS

Single Tone

POWER OUTPUT (APPROX) $= \frac{(700)(.600)}{4} = \frac{420}{4} =$ 105 watts
1 TUBE

$2P_o = 210$ watts

TWO TUBES P.O. = 210 WATTS

$R_{L_1} = \frac{(700)^2}{210} = 2,350\ \Omega$

$R_{L_2} = 1,175\ \Omega$

APPROXIMATE VALUES OBTAINED USING FORMULAS
P. 58 SB TECHNIQUES BRUENE

$I_{DC} = \frac{.600}{\pi} = 191$ Ma (ONE TUBE) ←

TUBES = 380 Ma ←

$P_{IN} = (.191)(700) = 134$ WATTS (ONE TUBE) ←

TWO TUBES $P_{IN} = 268$ WATTS

DISSIPATION $P_D = 268 - 210 = 58$ WATTS

% EFF $= \frac{210}{268} \times 100 = 78.4\%$

$R_L =$

$A = .210,\ B = .200,\ C = .165,\ D = .115,\ E = .075,\ F = .045$

$G = .025$

$$I_{1P} = \frac{1}{12}\left[.210 + 1.93(.200) + 1.73(.165) + 1.41(.115) + (.075) + .52(.045)\right]$$

$$I_{1P} = \frac{1}{12}\left[210 + 386 + 286 + 162 + 75 + 23\right]$$

$$I_{P_1} = \frac{1142}{12} = 95.3\ Ma)$$

TWO TUBES 191 Ma ←

$P.O._{UTPUT} = (.0953)(700) = 67$ ←

$$I_{AV\,(D.C)} = \frac{1}{12}\left[.105 + .200 + .165 + .115 + .075 + .045 + .025\right]$$

$$= \frac{730}{12} = 60.8\ Ma$$

TWO TUBES = 121.6 = 122 Ma ←

D.C. INPUT = .122 (950) = 116 ←

PLATE DISSIPATION

$P_D = 116 - 67 = 49$ WATTS ←

% EFFICIENCY $\frac{67}{116} \times 100 = 57.8\ \%$ ←

NE TUBE

$$R_L = \frac{e_p^{\,2}}{2P.O.} = \frac{e_p}{I_{1p}} = \frac{700}{95.3} = 7,350\ \Omega$$

TWO $R_L = 3,675\ \Omega$

COMPUTATION WHEN GRID SWINGS TO ZERO. $R_L = \frac{2e_p}{I_{ip}}$

ONE TUBE

$$R_L = \frac{2e_p}{I_{ip}} = \frac{(950-250)}{.184} = \frac{(700)}{.184} = 3{,}800\,\Omega \longleftarrow$$

$A = 400,\ B = 382,\ C = 318,\ D = 239,\ E = 145,\ F = 69,\ G = 25$

$$I_{AV}(\text{DC.}) = \frac{1}{12}\left[200 + 382 + 318 + 239 + 145 + 69 + 25\right]$$

$$= \frac{1378}{12} = 115\ \text{Ma.}$$

TWO TUBES $I_{AV}(\text{D.C.}) = \boxed{230\ \text{Ma}} \longleftarrow$

D. C. INPUT $= (.230)(950) = 218$ WATTS $\longleftarrow$

$$I_{iP_{\text{FUND.}}} = \frac{1}{12}\left[400 + 1.93(382) + 1.73(318) + 1.41(239) + 145 + .52(69)\right]$$

$$I_{iP} = \frac{1}{12}\left[\frac{2215}{12}\right] = 184\ \text{Ma.}$$

TWO TUBES $= 368$ Ma $\longleftarrow$

$$\text{P.O.} = \frac{(700)(.368)}{2} = 129\ \text{WATTS} \longleftarrow$$

$$\%\ \text{EFFICIENCY} = \frac{129}{218} \times 100 = 59.1\%$$

DISSIPATION $P_D = 218 - 129 = 89$ WATTS $\longleftarrow$

FOR REFERENCE ONLY

SHEET 1 OF 3 SHEETS

COLLINS

COMPONENT SPECIFICATIONS

COLLINS RADIO COMPANY, CEDAR RAPIDS, IOWA

PART NAME OSCILLATOR SUB-ASSEMBLY

SPECIFICATION & PART NUMBER/S 278 0091 00 *

TYPE BFO

APPROX. WT.

DESCRIPTION Beat Frequency Oscillator Sub-Assembly consiting of Coil, Capacitors, and resistor as required. Unit shall be in accordance with BuShips Specification 16T36, Grade A, as applicable.

— ASSOCIATED DATA —

Joint Army-Navy Specification JAN-C-92
Military Specification MIL-P-79
Military Specification MIL-P-3115A
Military Specification MIL-V-173a.

Circuit Application: Beat Frequency Oscillator circuit with type 6BA6 tube.

Coil Assembly Tuning: Iron core adjustable from top of unit and variable capacitor adjustable from side of unit.

Frequency Range: 480 KC to 520 KC (minimum range by core adjustment). See Note 1.

Capacitor Tuning Range: ±3 KC minimum
±4 KC maximum. See Note 1.

Materials and Components:

Capacitor C_1; 1600 mmfd button style silver mica, resin sealed, Characteristic E, Sangamo type M-72 or Collins approved equivalent. Capacitor is similar to Collins Part Number 912 0967 00.

Capacitor C_2; Variable air dielectric 4.7 to 42 mmf Hammerlund No. 36818-4 or Collins approved equivalent.

Capacitor C_3: 50 mmf ±1.0 mmf with temperature coefficient zero PPM ±30 PPM Centralab type 931 or Collins approved equivalent. Capacitor is similar to Collins Part Number 913 0059 00.

Capacitor C_4; 50 mmf compensating capacitor to be added by Collins Radio Company. (See note 1)

Capacitor C_5; JAN type 100 mmf ±10% ceramic or silver mica, Characteristic C or better. Capacitor is similar to Collins Part Number 916 4060 00.

Resistor R_1; 100,000 ohm ±20% 1/2 watt in accordance with JAN-R-11 type R6226.

Shield Can: Aluminum with Chromate Dip finish; (Iridite No. 14-Alcoate: Allied Research Products, Inc.) Cans shall be properly degreased before application of finish.

Phenolic Materials: Phenolic Tubing and sheet stock shall be in accordance with MIL-P-79 and MIL-P-3115A respectively, Grade PBE or better.

Fungicidal Treatment: All organic materials shall be fungi inert or treated to be fungus resistant with a coating material in accordance with Military Specification MIL-V-173a.

Cores: Powdered Iron Core shall be rustproofed with manufacturer's standard rustproofing materials. Core dimensions are as follows; .375 inches long, .375 inch diameter.

Coil Form: Phenolic tubing 0.408 inch outside diameter by 0.376 inch inside diameter.

Service Conditions:

Altitude; to 10,000 feet above sea level.
Temperature; -55°C to +70°C.
Humidity; 95% RH.

* When part number appears as 278 0091 009, Military Inspection is required.

Tolerance Unless Otherwise Specified: Fractional: ± 1/32 Decimal. ± Angle: ± Scale: Detail:

MANUFACTURER	MFG. TYPE	MFG. CAT. NO.	COLLINS SAMPLE NO.
Aladdin TA			
Communication Coil TA			

CAL change 10-7-55

ENGINEER Wm Brandt APPROVED J Meeks CHECKED DEL DATE 2/21/53

REVISION						
0	11-6-50	3	R38505 1-6-55	6	
1	R23084 2-26-53	4	R50357 12-5-56	7	
2	Addition 9-14-53	5		8	

PD-446C—Part No. 074-0539-00—

FOR REFERENCE ONLY

Marking: Windings shall be connected to base terminals as indicated. Collins Part Number shall be stamped on top of case. Ink stamping lacquer coated will be considered acceptable, but shall be clearly legible after humidity testing.

Winding Data: Start 1/8" from bottom of form. Wind 81 turns #9-41 Litz with 3/8" cam. Tap at 31 turns from start.

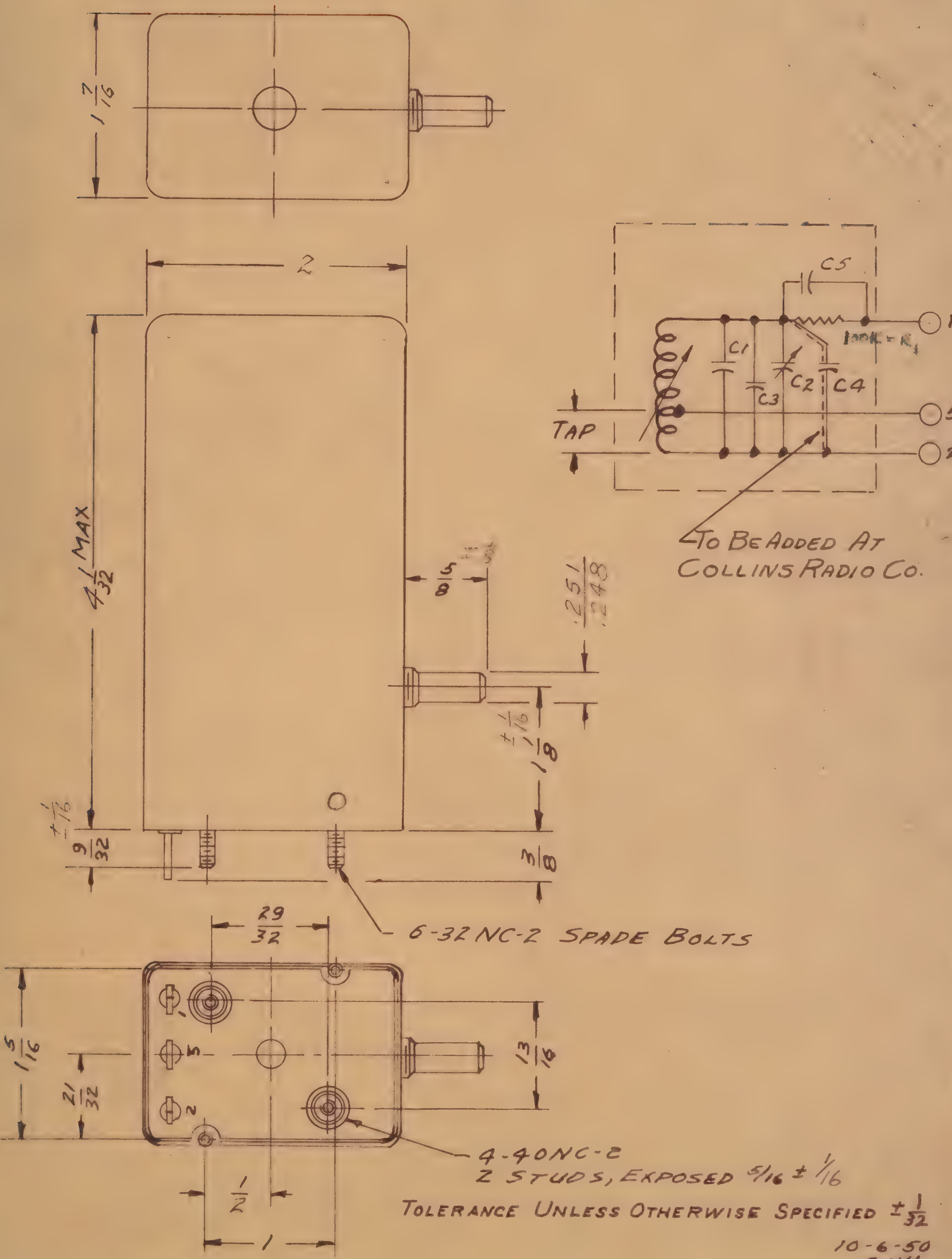
NOTES:

1. Capacitor C_4 is not supplied by manufacturer but is to be added by Collins Radio Company by selective assembly in accordance with assembly drawing 505 2122 002. Frequency specifications are with capacitor C_4 added.
2. This unit is similar to Collins Part Numbers 278 0027 00 and 278 0081 00.

CAL change 10-7-55

Tolerance Unless Otherwise Specified:		Fractional: ± 1/32		Decimal: ± Angle: ±		Scale: Detail:
REVISION	0	11-6-50	3	R38505 1-6-55	6	
	1	R23084 2-26-53	4	R50357 12-5-56	7	
	2	[illegible]-14-53	5		8	

FOR REFERENCE ONLY



TOLERANCE UNLESS OTHERWISE SPECIFIED ±1/32

10-6-50
GHH

FOR REFERENCE ONLY

COLLINS

SHEET 1 OF 3 SHEETS

TRANSFORMER SPECIFICATIONS

COLLINS RADIO COMPANY, CEDAR RAPIDS, IOWA

FREQUENCY RESPONSE
____ C.P.S. ____ DB.
____ C.P.S. ____ DB.
____ C.P.S. ____ DB.
TURNS RATIO ____ TO ____
SEC ____
SEC ____

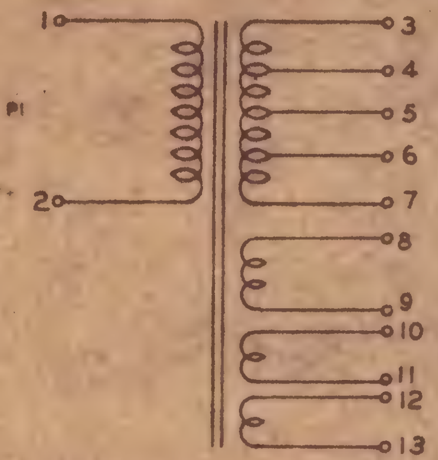
CASE TYPE Drawn Steel
FINISH ____
POWER ____
PRI. VA ____
SEC. VA ____
SUPPLY FREQUENCY 50/60 cps

PART NO. 662 0146 00
CLASSIFICATION 2
FILE NO. ____
DESIGN SPEC. NO. TR-102B
WEIGHT ____

DESCRIPTION Power transformer in accordance with the latest version of RTMA Specification TR-102B.

TERMINALS: PRI Solder Lug Type SEC Solder Lug Type
DIRECT CURRENT: PRI Zero SEC. 280 ma dc

VOLTAGE/			CURRENT	TEST	R	Toler-
LEAD	LEAD	VOLTS/	RMS	VOLTAGE	OHMS	ance
				RMS		
1	2	115		1600		
3	7	800	280 MADC	1600		Note 1
	5	CT				
4	6	270	10 MADC			Note 1
8	9	5.0	4.0A	1600		±3%
10	11	6.6	9.0A	1600		±3%
12	13	12.6	0.3A	1600		±5%



Ambient Temperature Range: 0°C to 40°C.

Temperature Rise: Shall not exceed 55°C above an operating ambient of 40°C when operated at rated load and specified duty cycle for a sufficient length of time to reach normal operating temperatures.

Duty Cycle: Continuous.

Altitude: Sea level to 10,000 feet operating.

Case: Drawn steel, compound filled with terminals extending from mounting surface.

Terminals: Solder lug type terminals shall pass through the area indicated on Sheet 3 with sufficient clearance to avoid binding. Terminal detail design is optional but shall be approved by Collins Radio, or the Prime Contractor if other than Collins, before proceeding with production quantities.

Voltage Tolerance: The specified terminal voltage shall be measured at the prevailing room ambient (25°C) after the unit has been operated under full load conditions for a sufficient length of time to reach normal operating temperature.

Acoustic Noise: Acoustic noise shall be 10 db minimum below one dyne/cm^2 at a distance of 2 inches with transformer operating under rated conditions.

Finish: Semi-gloss black finish.

CAL Change 12-10-56

Tolerance Unless Otherwise Specified: Fractional: ± Decimal: ± Angle: ± Scale: Detail:

MANUFACTURER		MFG. TYPE	MFG. CAT. NO.	SAMPLE NO:
Audio Development	TA	A8393		044 3167 01
Chicago Std. Trans.	TA			
Collins Radio	TA			DWG. CHECK ____ DATE ____

ENGINEER E. Senti APPROVED J. Mechlin DESIGN CHECK TEL DATE 11/4/53

REVISION						
0	3-25-54	3	R41561 7-20-55	6	
1	R37649 11-11-54	4		7	
2	R38962 2-4-55	5		8	

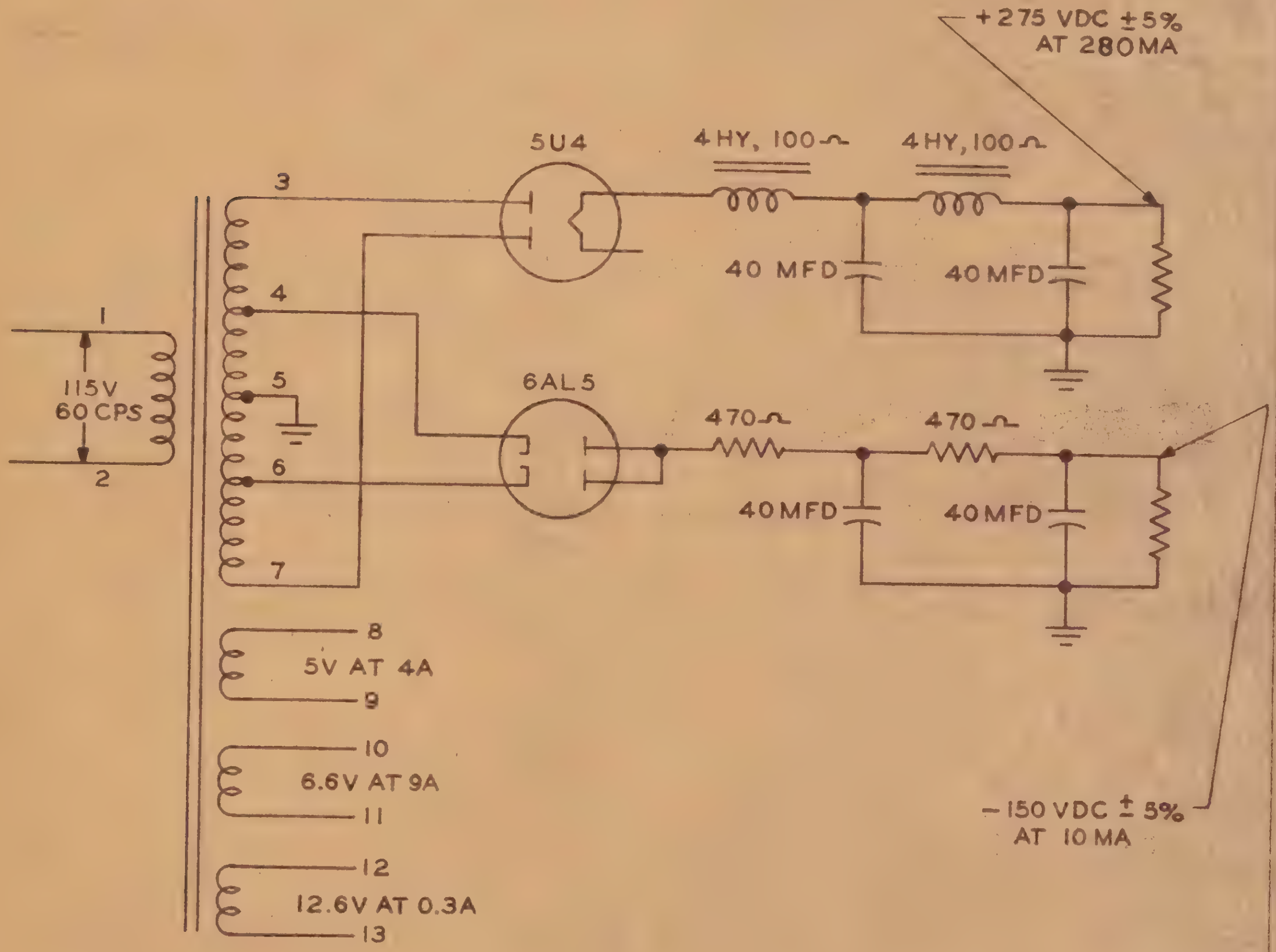
FOR REFERENCE ONLY

COLLINS

Markings: Markings shall be in strict accordance with the requirements of RTMA TR-102B and shall include the Collins Part Number and the Manufacturer's name and type number.

Sample Approval: Sample approval must be obtained from Collins Radio Engineering Department or the Prime Contractor before proceeding with production. All the electrical and mechanical requirements specified will be checked before granting sample approval.

NOTE 1: Secondary winding terminals 3 through 7 shall be as required to deliver the voltage specified when connected in the rectifier circuits shown below with center tap ground.



CAL change 12-10-56

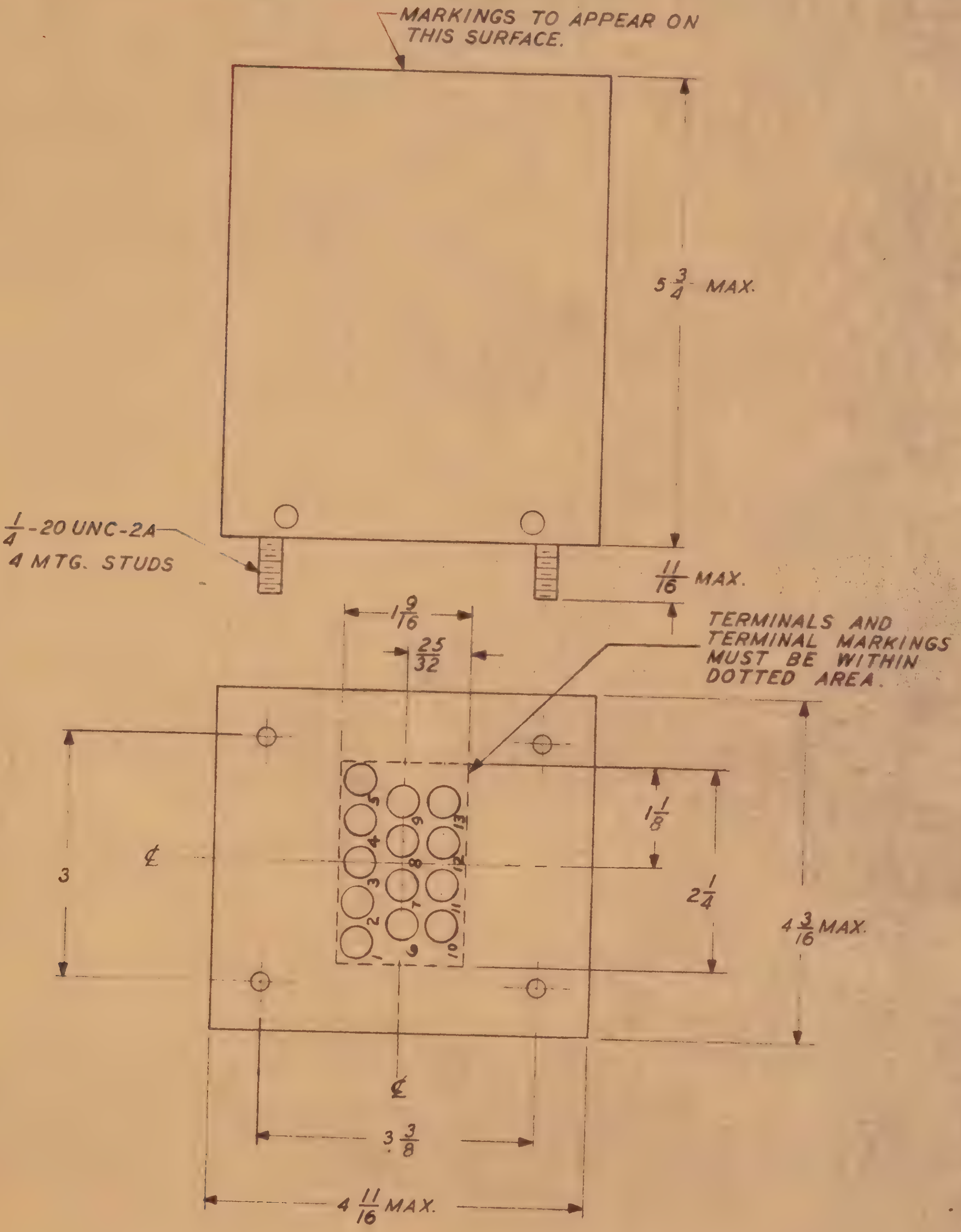
1-26-55

Tolerance Unless Otherwise Specified: Fractional: ± 1/64		Decimal: ±.005	Angle: ± 1°		Scale: ——	Detail: E M H
REVISION	0	3-25-54	3	R41561 7-20-55	6	
	1	R37644 11-11-54	4		7	
	2	R38962 2-4-55	5		8	

DR 1.5

FOR REFERENCE ONLY COLLINS

SHEET 3 of 3 SHEETS
SPECIFICATION 662 0146 00



CAL change 12-10-56

Tolerance Unless Otherwise Specified: Fractional: ± 1/64 Decimal: ±.005 Angle: ± 1° Scale: ~ 3-23-54 Detail: M.M.S.

REVISION	0	3-25-54	3	R41551 7-20-55	6	
	1	R37644 11-11-54	4		7	
	2	R38962 2-4-55	5		8	

PD-721 074-0948-00

FOR REFERENCE ONLY

SHEET 1 OF 2 SHEETS

COLLINS

COMPONENT SPECIFICATIONS

COLLINS RADIO COMPANY, CEDAR RAPIDS, IOWA

PART NAME TRANSFORMER

SPECIFICATION & PART NUMBERS 278 0061 00

TYPE I.F.

APPROX. WT.

DESCRIPTION I.F. Transformer working from type 6BA6 to type 6BA6 tube.

NAVY TYPE NUMBER

— ASSOCIATED DATA —

Design Data:

Capacitors: C_1 and C_2, 470 mmf ± 2%.

Temperature Coefficient ± 100 PPM per degree C.

C_3, 6800 mmf ± 5%. Temperature coefficient ± 100 PPM per degree C.

Inductance (with iron core in center of inductance variation): 255 microhenry ± 5%.

Design Center Value of Q: 180

Design Center Value of N (See Note 3): 1.8

Frequency: 455 KC (adjustable from 445 KC to 465 KC).

Performance Factor:

XQ (See Note 4) = 32,000 ± 15% (See Note 2).

Physical Requirements:

Shield Can: Aluminum drawn or extruded. Finish - NASAT brightening finish, or approved equivalent, or extruded zinc cans with bright iridite finish.

Soldering: Wrap all connections for mechanical strength before soldering.

Leads: Capacitor and coil leads shall be as short as possible.

Impregnant: If coils are impregnated with wax or other compound, compound shall not flow when subjected to specified ambient temperature range.

Marking: Collins Part No. shall be stamped on top of shield can. Ink stamping lacquered will be considered acceptable.

Workmanship: Transformers shall be manufactured and processed in a careful and workman-like manner in accordance with good design and practice.

Ambient Temperature: 0 to 50°C.

NOTES:
1. Manufacturer shall submit to Collins Radio Company fifty (50) sample units for sample approval. Approval of the sample lot must be obtained before the production order is submitted.
2. Each production unit will be inspected for conformance to the XQ specification as indicated.
3. N is defined in the ratio of actual coefficient of coupling to critical coefficient of coupling for over coupled circuits. $\left(N = \frac{Ka}{Kc}\right)$
4. For XQ measurements, X and Q are values of the transformer primary with secondary in resonance unterminated. Shield can is grounded to rf ground terminals of both primary and secondary.
5. If necessary to meet electrical specifications, shunting resistors may be placed across primary and secondary windings.
6. Primary coil shall be located at top of coil form and secondary coil shall be located on bottom of coil form.

CAL change 9-12-56

Tolerance Unless Otherwise Specified: Fractional: ± Decimal: ± Angle: ± Scale: Detail:

MANUFACTURER	MFG. TYPE	MFG. CAT. NO.	
Aladdin Radio Ind. TA			
Electro Assy. TA			
			DWG. CHECK EWL DATE 7/19/47

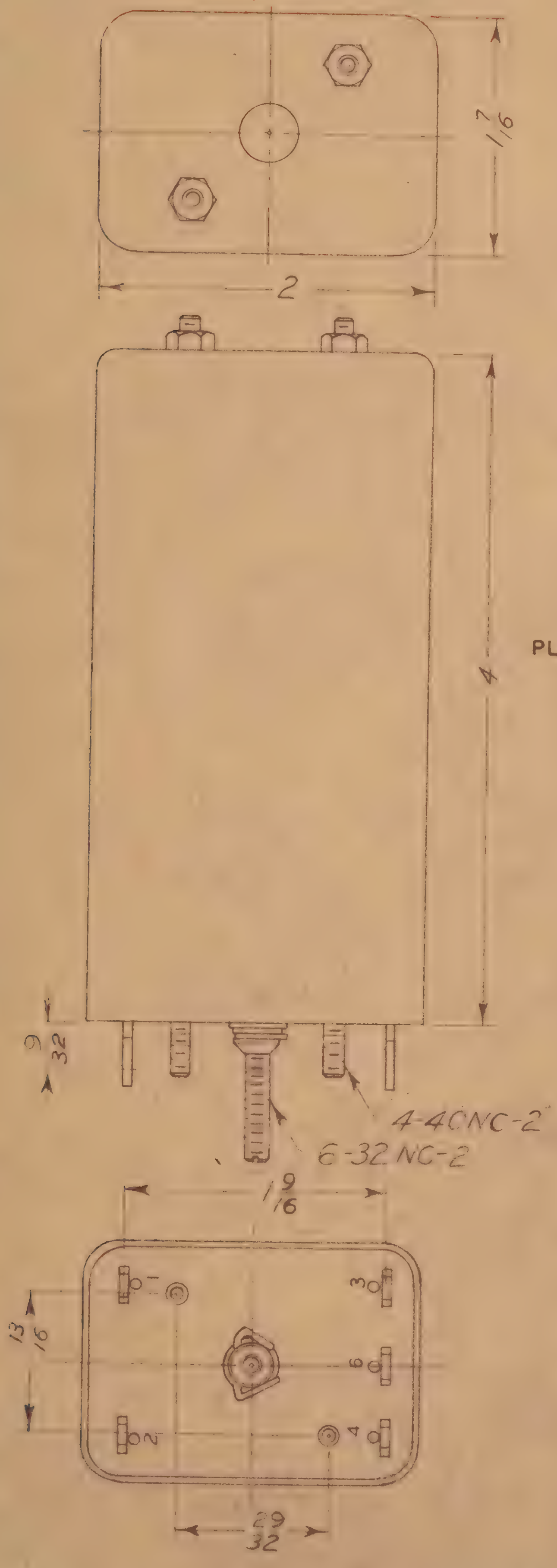
ENGINEER APPROVED V. L. Hudik DESIGN CHECK DATE

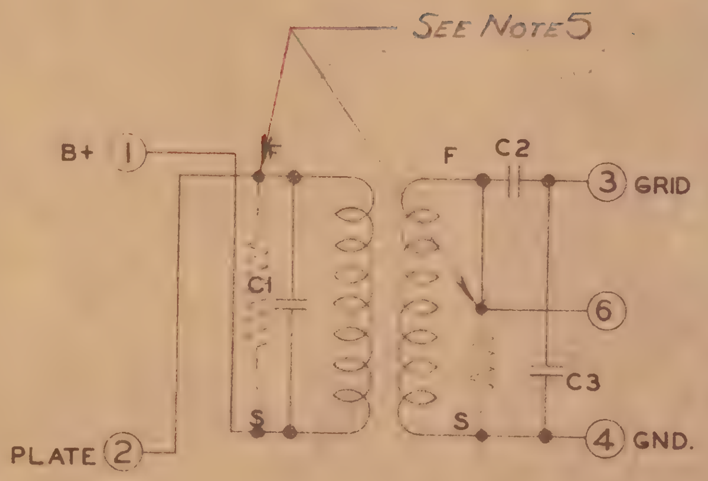
REVISION						
	0	9-11-47	3		6	
	1	D20119 1-2-48	4		7	
	2		5		8	

PD-446A—Part No. 074-0539-00—1M-3-47—N9359—33572

FOR REFERENCE ONLY

SHEET 2 OF 2 SHEETS
SPECIFICATION 278 0061 00





SCALE 1=1
D.F.S. 9-4-47

FOR REFERENCE ONLY

COLLINS

SHEET 1 OF 2 SHEETS

TRANSFORMER SPECIFICATIONS

COLLINS RADIO COMPANY, CEDAR RAPIDS, IOWA

FREQUENCY RESPONSE

CPS DB

CPS DB

CPS DB

TURNS RATIO TO

SEC

SEC

SEC

CASE TYPE 2E

FINISH Collins Gray

WEIGHT

POWER

PRI VA

SEC VA

SUPPLY FREQUENCY 50/60 cps

NUMBER

PART NO. 662 0014 00

TYPE NO.

ELEC SPEC NO.

MECH SPEC NO.

CLASSIFICATION 2A1

FILE NO. 21

DESIGN SPEC NO.

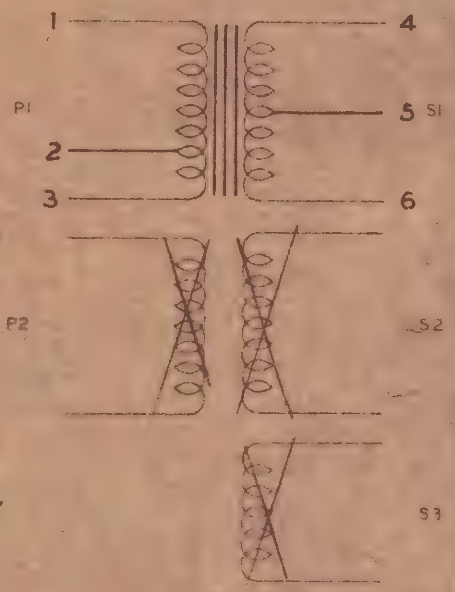
DESCRIPTION Power transformer to deliver 570 or 720 volts DC from two rectifier type 5R4GY at 0.350 amperes with choke input.

TERMINALS: PRI 3 leads 6 inches long SEC 3 leads 6 inches long

DIRECT CURRENT: PRI None SEC None

Case: Thordarson KTV-6

Lead Color:
1. Black
2. White
3. Blue
4. Red
5. Green
6. Yellow



*Using Primary Connections 1 and 2 on 115 volts the secondary voltage 4 to 6 shall not exceed 1920 volts rms, with open circuited secondary, with primary connections 1 and 3, secondary open circuit voltage shall not exceed 1540 V.

Note: Humbucking Construction

VOLTAGE/IMPEDANCE			CURRENT	TEST	
LEAD	LEAD	VOLTS/OHMS	RMS	VOLTAGE	
1	2	*115		3000	
4	6	1540 V	.248A	3000	
5		C.T.			
1	3	*115 V			
4	6	1240 V	.248A		
5		C.T.			

TEST DATA			
REG	L OR X	R	LEAKAGE
D16365	9/25/46		
D21327	7-9-48		

XX	MFG'R
XXXXX MANUFACTURER	XXXXX NO.
Thordarson	T-50021-A

ENGINEER G A Hunter

DATE

APP'D O.K. Myhre

RECORDED

TEST

FILED 5-22-46

FOR REFERENCE ONLY!

COLLINS

SHEET 1 OF 2 SHEETS

REACTOR SPECIFICATIONS

COLLINS RADIO COMPANY, CEDAR RAPIDS, IOWA

NUMBER 668 0055 00
PART NO.
TYPE NO.
ELEC. SPEC. NO.
MECH. SPEC. NO.
CLASSIFICATION
FILE NO.
DESIGN SPEC. NO.

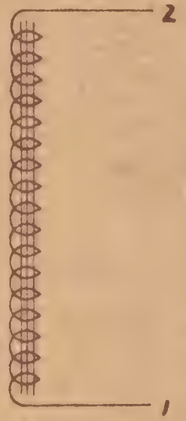
FREQUENCY RESPONSE
C.P.S. DB
C.P.S. DB
C.P.S. DB

FIGURE OF MERIT
Q= @ CPS
Q= @ CPS
Q= @ CPS

CASE TYPE
FINISH Black
WEIGHT
POWER
RATED VA
FREQUENCY 120 cps
TEST VOLTAGE 3500 V RMS

DESCRIPTION Filter Reactor

TERMINALS Wire Leads
WIRE SIZE
IMPRESSED A-C VOLTAGE Inductance measured at 50 volts RMS, 60 cps.
AIR GAP



~~VOLTAGE~~/INDUCTANCE			CURRENT	LIMITS	R	
LEAD	LEAD	~~VOLTS~~/HENRYS		%	OHMS	
1	2	4.25 min.	0.350A	-	70 max.	

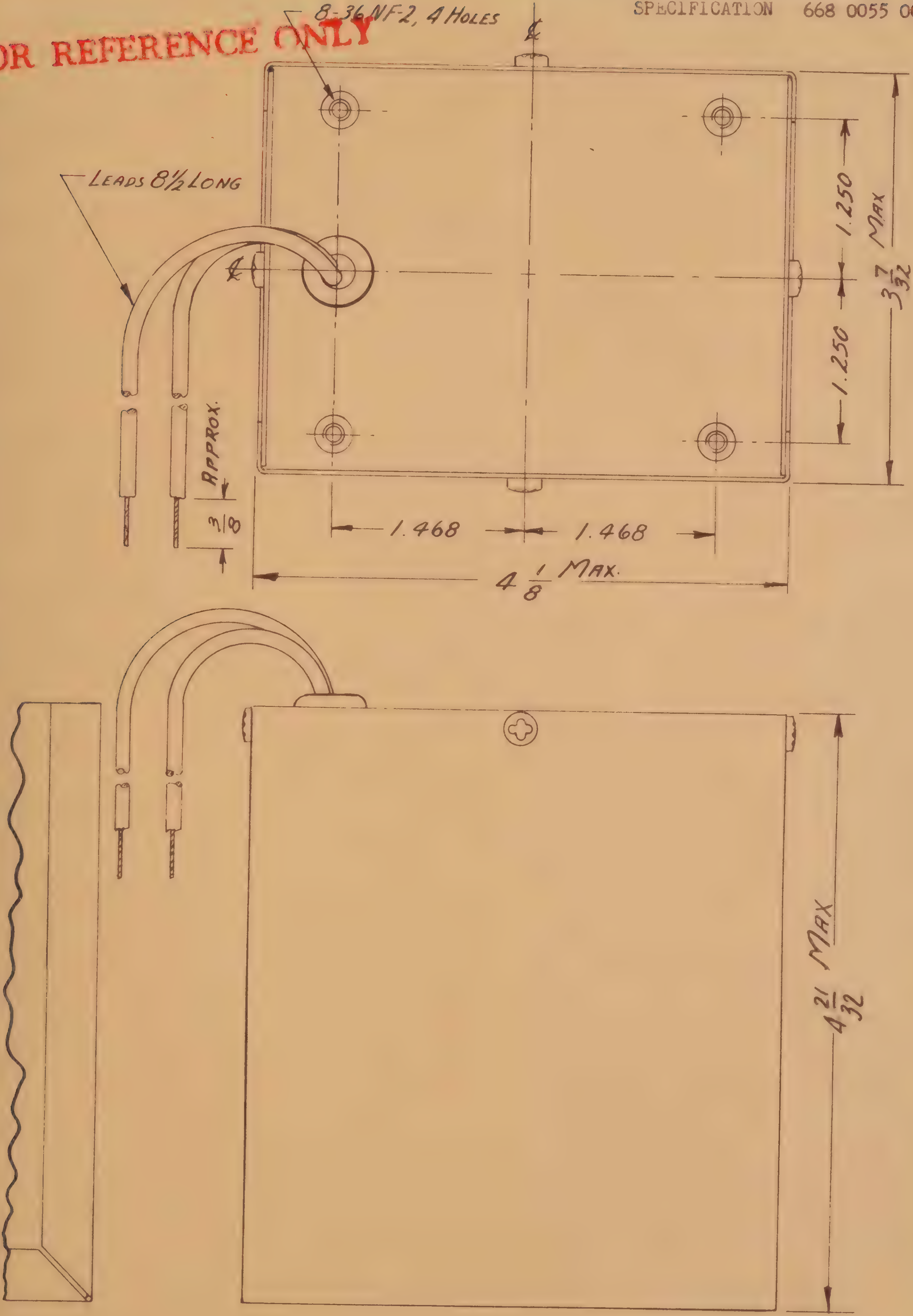
TEST DATA				
VOLTS / AMP	HENRYS	FREQUENCY	Q	R
REVISION	DATE			
R3699	[illegible]			

~~LIST~~	MFG'R
~~RESALE~~	SYMBOL
Audio Development Co.	A6689

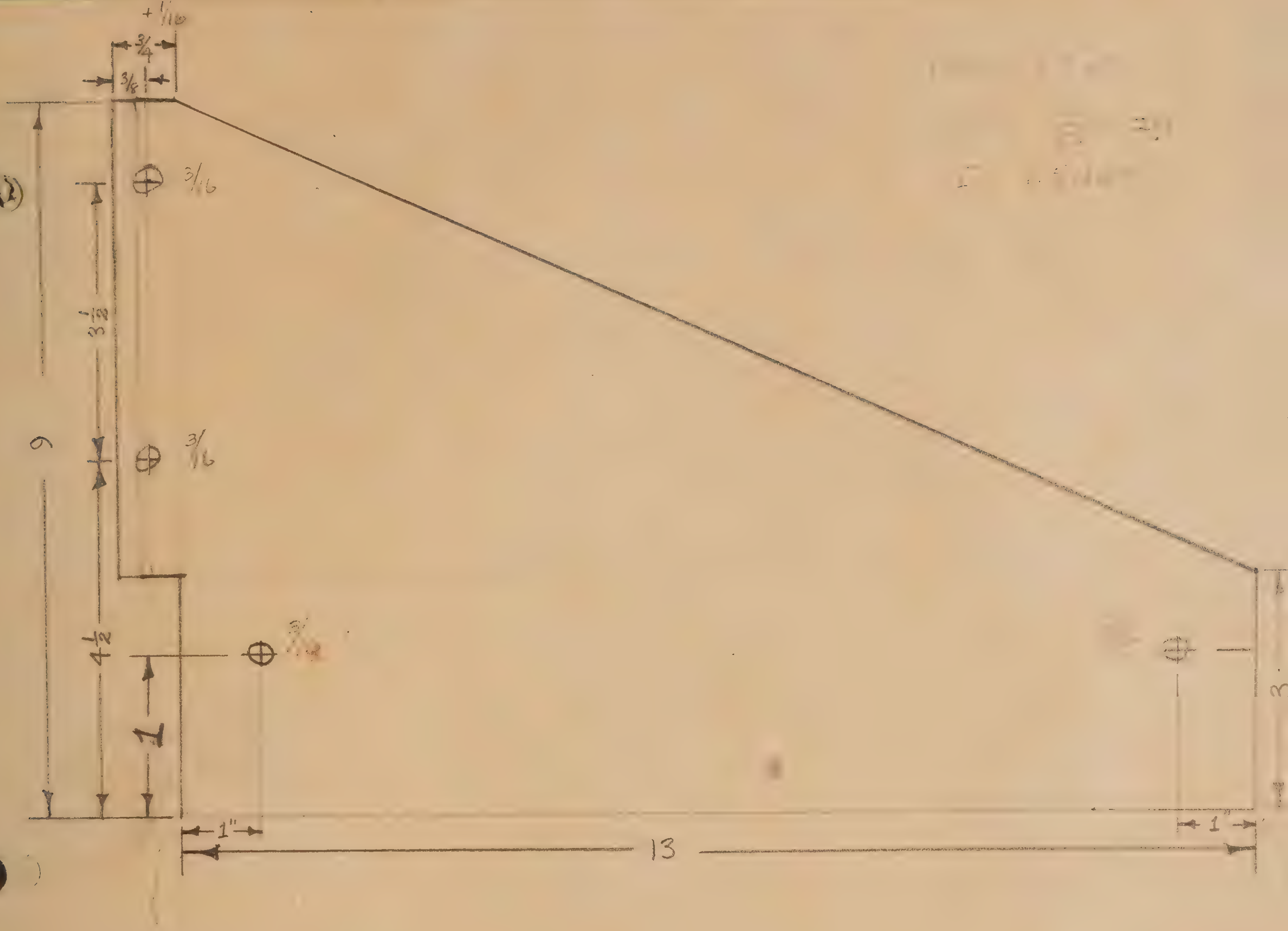
ENGINEER
DATE
APP'D
RECORDED
TEST
FILED 5-18-49

FORM NO F-40-8

FOR REFERENCE ONLY



TOLERANCES:- DECIMAL ±.010
FRACTIONAL ±1/64
UNLESS OTHERWISE SPECIFIED



Two Req'd.

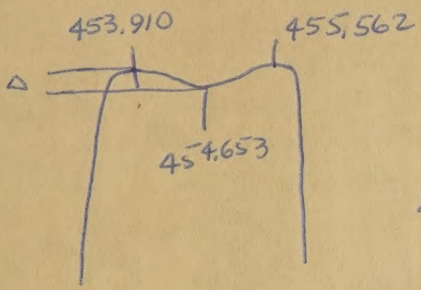
1 Left Side

1 Right Side.

MECHANICAL FILTER (MODIFIED)

1 VOLT RMS INPUT

INSERTION LOSS INPUT & OUTPUT PARALLEL TUNED = 26 DB



PEAK TO VALLEY Δ = 2.6 DB

20 Db DOWN POINTS 453.015
456.851

SMEAD'S
PRESSBOARD
GENUINE

COVER
No. R-129S

MANUFACTURED BY
THE SMEAD MANUFACTURING COMPANY